Water Works and Sewerage

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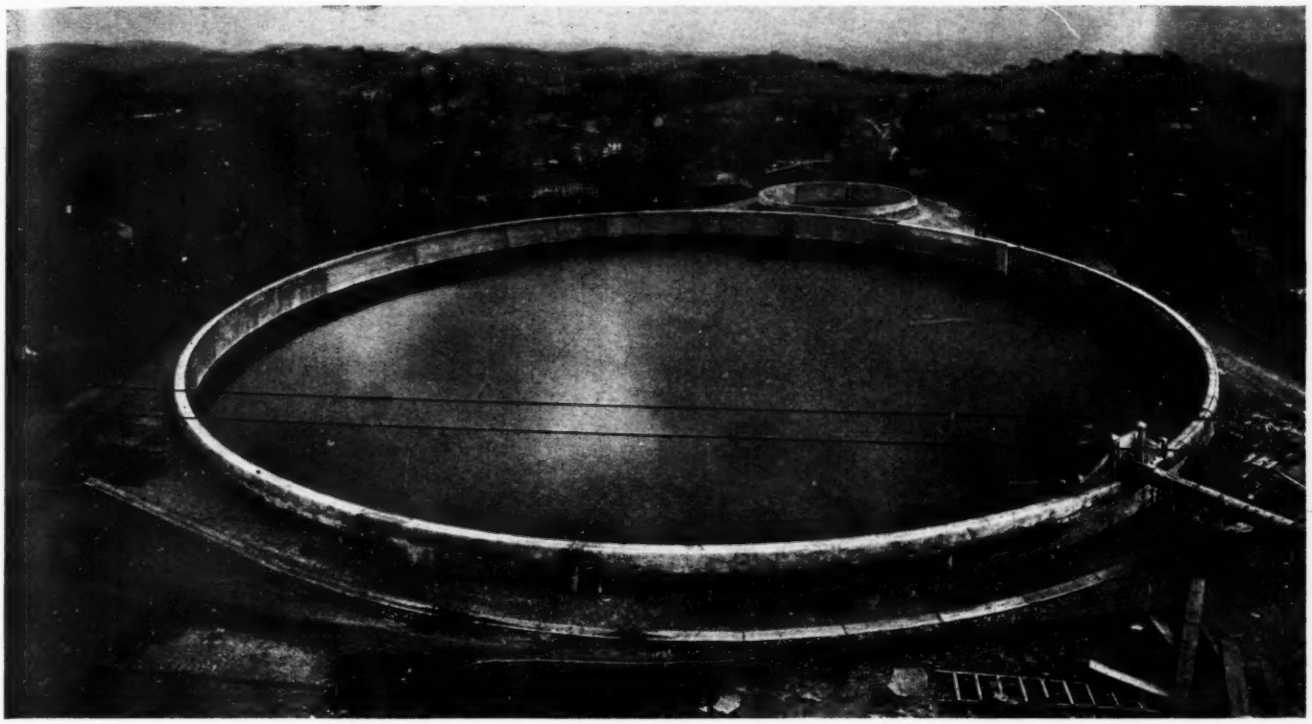


McNaugher Reservoir; A Secondary Reservoir Completed in 1928; 5,500,000 Gal. Capacity

The Water Works of Pittsburgh

THE water plant of Pittsburgh consists primarily of two river intakes, a low lift pumping station, a filter plant with its sedimentation, filtration and water storage facilities, two primary pumping stations, four secondary pumping stations, two primary distribution systems and six secondary, or high service, distribution systems. The cost of the Water Works to Jan. 1, 1931 has been $36,765,000. The reproduction cost is $68,000,000 and the annual operation-maintenance cost is $1,600,000.

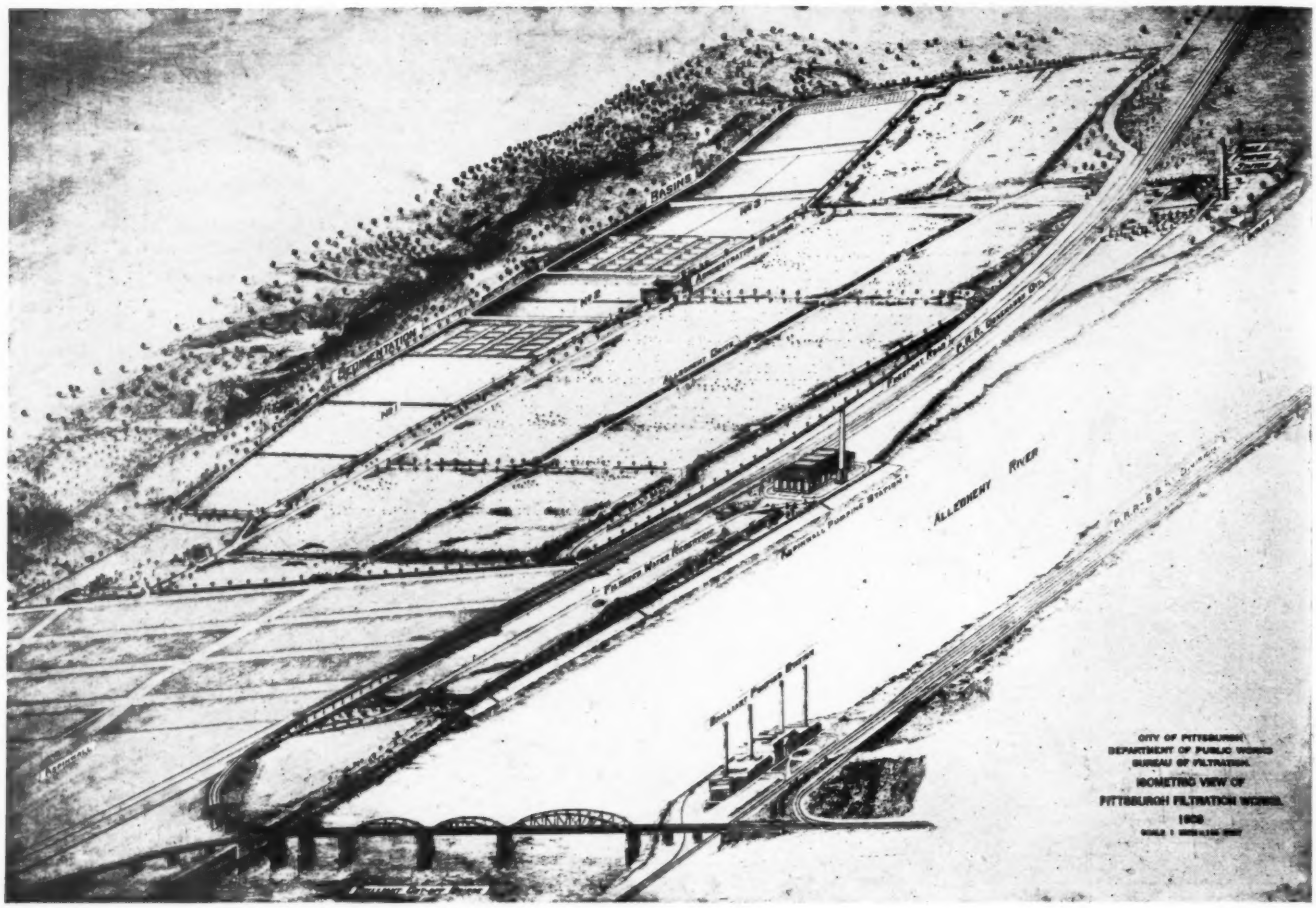
The unusual features of the water distribution systems are due almost entirely to the rugged topography of the city, the outstanding features of which are many hills, separated by deep ravines and wide rivers, with few level spaces. This topographical condition results in a complicated system of water distribution districts, requiring a large amount of secondary pumpage to the high hills, the highest of which is nearly 700 ft. above the level of the rivers at the "Point."

River Intake.—The water supply is obtained from the Allegheny River near Aspinwall and the filter plant at the easterly boundary of the City, and about seven miles from the junction of the Allegheny and Monongahela Rivers. Here the water enters the system through two concrete intakes controlled by large sluice gates, and passes through suction trunks at either end of Ross pumping station to the pumps of that station. Both suction trunks are of concrete,—one is 124 in. in diameter, the other (installed in 1928) is composed of two parallel conduits 84 in. in diameter.

Raw Water Pumping Station.—Ross Station is the low lift pumping station which delivers all of the raw river water to the adjacent filter plant. It is equipped with two 100 M.G.D. and one 50 M.G.D. steam turbine driven centrifugal pumps, also one 50 M.G.D. and one 35 M.G.D. centrifugal pumps driven by vertical steam engines. The steam plant consists of two 600 H.P. sterling type boilers of 400 lb. steam pressure, with 6 smaller boilers used only as reserve equipment.

Filter Plant.—The water pumped at Ross station passes through a 96-in. diameter, steel, concrete incased conduit, about 2,000 ft. in length, to the receiving basin of the filter plant. The water elevation in the basin is 47.5 ft. above the river pool level. The receiving basin is the middle and smaller one of three sedimentation basins; has an area of about three acres, and contains about 12 M.G. A large part of the heavy suspended matter is deposited as the water passes through this basin. The water leaves the receiving basin through eight 48-in. outlets, to enter the rapid filters located in the sedimentation basin adjacent to the receiving basin.

Both of the sedimentation basins are equipped with 24 reinforced concrete, rapid filter units, each being a rectangular compartment approximately 60 ft. by 40 ft. in area, and containing 6 vertical ft. of gravel. A large amount of the remaining suspended matter is removed from the water in its passage through the rapid sand filters, and the water loses still more of this matter in its course through the large sedimentation basins after having passed through the rapid filters.



Isometric View of Pittsburgh's Filtration Plant, Showing Also the Location of Brilliant, Aspinwall and Ross Pumping Stations

Each of the two large sedimentation basins has an area of about 12 acres, a capacity of 54 M.G., and a depth of 15 ft. The water passes through the sedimentation basins at the ends farthest removed from the central receiving basin, into a concrete conduit 96 in. in diameter which is the source of supply of the slow sand filters.

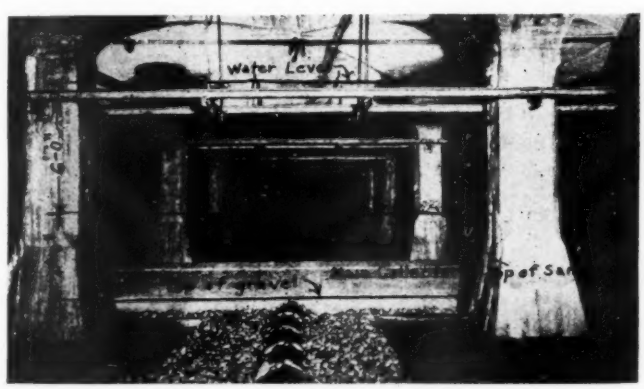
There are 56 slow sand filters arranged in five groups. The filters of each group are ranged on either side of an operating gallery, an underground work room 31 ft. wide and about 1,000 ft. long, and which contains the valves, piping, entrance doors to individual filters, regulating and measuring devices, sand washing machinery, and all other equipment necessary for the operation of the filters.

Each filter is an underground, concrete room, or compartment, 1 acre in area and 12 ft. in clear height from floor to roof. The roof is of groined arch construction, supported by square concrete piers spaced 15 ft. center to center. Upon the floor of each filter are open jointed tile pipe lines for the purpose of collecting the filtered water and conveying it to filtered water pipes located in the adjacent gallery. Around and over these tile collecting pipes is the filtering medium consisting of 1 ft. of gravel and about 3 ft. of graded sand. The filtration process consists of filling a filter with water to a depth of about 6 ft. above the sand, and of feeding water downward through the sand and gravel to the collecting pipes located on the floor of the filter. These filters are operated at varying rates, the maximum being about 3½ M.G.D. per acre. The filters and galleries are covered with about 3 ft. of soil as a protection against frost, and for reasons of general appearance.

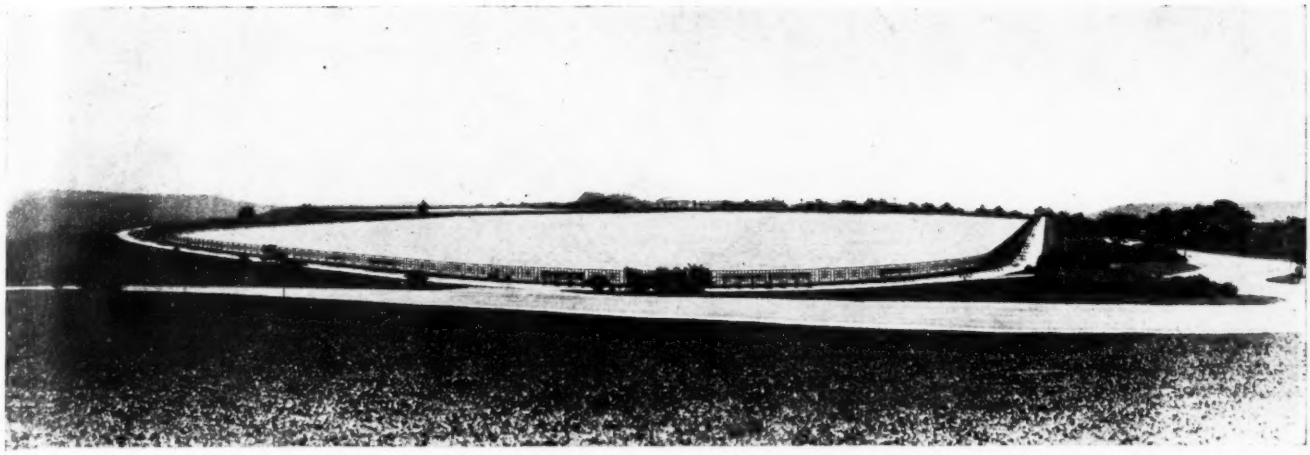
The water from the slow sand filters is collected in filtered water pipes in each gallery and passes to the filtered water conduit, a concrete conduit 124 in. in diameter, which leads to the filtered water reservoir. As the water enters the filtered water reservoir, a slight admixture of liquid chlorine is made as an additional precaution in producing a safe drinking water.

The filtered water reservoir stores about 50 M.G. of water prepared for consumption. This reservoir is built of concrete and, like the filters, it is covered and has a groined arch roof.

During the course of the water from the river intake through the filter plant, or from its raw and highly contaminated stage to its filtered and highly sanitary stage, continuous bacteriological and chemical analyses are made by the laboratory force stationed in the administration building, and this filtration division also retains



One of the 56 Filter Beds—Each One Acre Capacity



Highland Reservoir No. 1, 117,000,000 Gal. Capacity, Completed in 1879

responsibility for the sanitary character of the water after filtration, when it has been turned over to the mechanical division for pumpage, and to the distribution division to be served to consumers. For this purpose, continuous analyses are made of water samples taken from the several reservoirs, and from each of the distribution service districts.

Primary Distribution Systems.—There are two primary service systems for the distribution of water:—

Low Service.—With its Highland No. 2 Reservoir supplied from Brilliant Station, and its Lanpher Reservoir supplied from Aspinwall Station; and Highland No. 1 Service.—With its Highland No. 1 Reservoir supplied from Brilliant Station.

Before describing the primary service systems, the following description of the major units of these systems is given:

Aspinwall Station.—A primary pumping station, located on the northerly bank of the Allegheny River at the filter plant, completed in 1914, contains four 20 M.G.D. vertical triplex pumping engines and six boilers. It obtains water from the filtered water reservoir through a 60-in. suction main, and delivers it to Lanpher reservoir of the low service system.

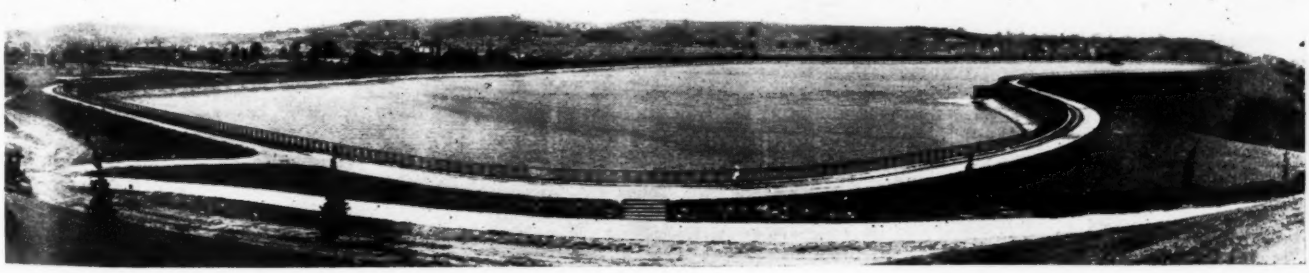
Lanpher Reservoir.—A primary reservoir, located in Shaler Township, about ½ mile north of Etna, completed in 1914, at an elevation of 971 ft. The capacity is 151 M.G., the depth of water 40 ft., while the supply is obtained from Aspinwall Station through a 60-in. steel rising main.

Brilliant Station.—A primary pumping station, located on the southerly bank of the Allegheny River, opposite Aspinwall, completed in 1879, contains four 12 M.G.D., four 15 M.G.D., and one 8 M.G.D. vertical triplex pumping engines, and seven boilers. Its supply is obtained from the filtered water reservoir through two 72-in. steel suction mains laid under and across the Allegheny River, and water delivery is made to Highland Reservoir No. 2 of the Low Service System and to Highland Reservoir No. 1 of the Highland No. 1 Service.

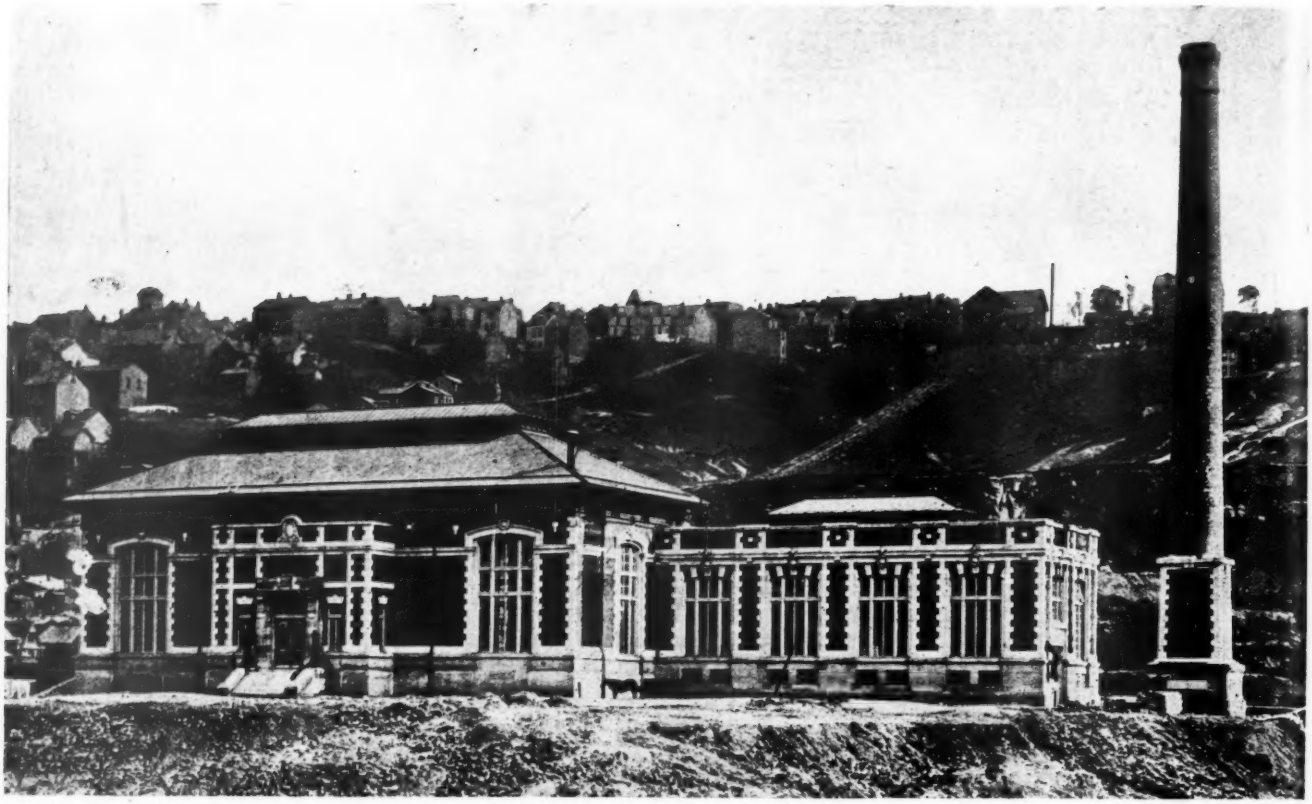
Highland Reservoir No. 2.—A primary reservoir of the low service system, located in Highland Park at the head of Negley Ave., completed in 1903, relined in 1927, at an elevation of 972 ft. The capacity is 126 M.G.D., the depth of water is 30 ft., while the supply is obtained from Brilliant Station through a 48-in. steel rising main.

Highland Reservoir No. 1.—A primary reservoir of the Highland No. 1 System, located in Highland Park, at the head of Highland Ave., completed in 1879, at an elevation of 1,066 ft. The capacity is 117 M.G., the depth of water 22 ft., while the supply is obtained from Brilliant Station through two 48-in. steel rising mains.

The low service system, through Aspinwall and Brilliant Stations, Lanpher and Highland No. 2 Reservoirs (elevation 971 and 972 ft. respectively), supplies the manufacturing and mercantile districts on both sides of the three rivers, from the low river elevation of 6r6 ft. to about 900 ft., containing a population of about 170,000. The major feeder mains of the system are a 60-in. steel main from Lanpher Reservoir to the heart of the lower North Side; a 50-in. steel main, changing to one 42-in. steel and one 36-in. cast iron main, leading from Highland Reservoir No. 2, along the Allegheny to the Point District, and a 50-in. steel main leading from the same reservoir, across the Central City and under



Highland Reservoir No. 2—A Primary Reservoir Constructed in 1903, Relined in 1927. Capacity 126 Million Gallons, Depth of Water 30 Ft.



Mission Pumping Station—a Secondary Pumping Station, Completed in 1912

the Monongahela River at South 34th St., to the low section of the South Side. It should be noted that the portions of the system lying on opposite sides of the rivers are cross-connected at 26th St., the Manchester Bridge, and the South 10th St. Bridge; also that the two reservoirs supplying the district being practically at the same elevation and cross-connected, act as one reservoir, and that either reservoir could, in case of necessity, supply the entire low service district.

The Highland No. 1 Service, through Brilliant Station and Highland Reservoir No. 1 (elevation 1,066 ft.), supplies a large residential, mercantile and manufacturing district of the Central City comprising East Liberty valley, Homewood, Shadyside, Bloomfield, Oakland, and Soho, between approximate elevations 900 ft. and 1,020 ft., and containing a population of about 180,000. One 36-in. and four 30-in. cast iron feeder mains radiate from Highland Reservoir No. 1 to all parts of the district.

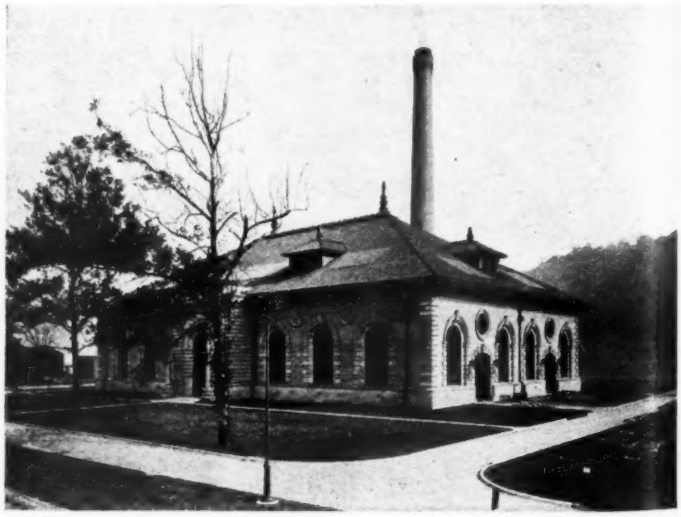
Secondary Distribution Systems.—There are six secondary distribution systems;—systems to which water is re-pumped from one of the primary distribution systems to higher elevations. The four secondary pumping stations, the four secondary reservoirs, and three tank sets are described with the systems in which they serve.

Herron Hill Service.—Through Herron Hill Station, taking its supply from Highland No. 1 primary service, and pumping to Herron Hill Reservoir (elevation 1,261 ft.), supplies a residential territory of the Central City located on four separated hills:—Herron Hill, Squirrel Hill, Garfield Hill and Heberton Hill, between approximate elevations of 1,000 to 1,230 ft., containing a population of about 100,000.

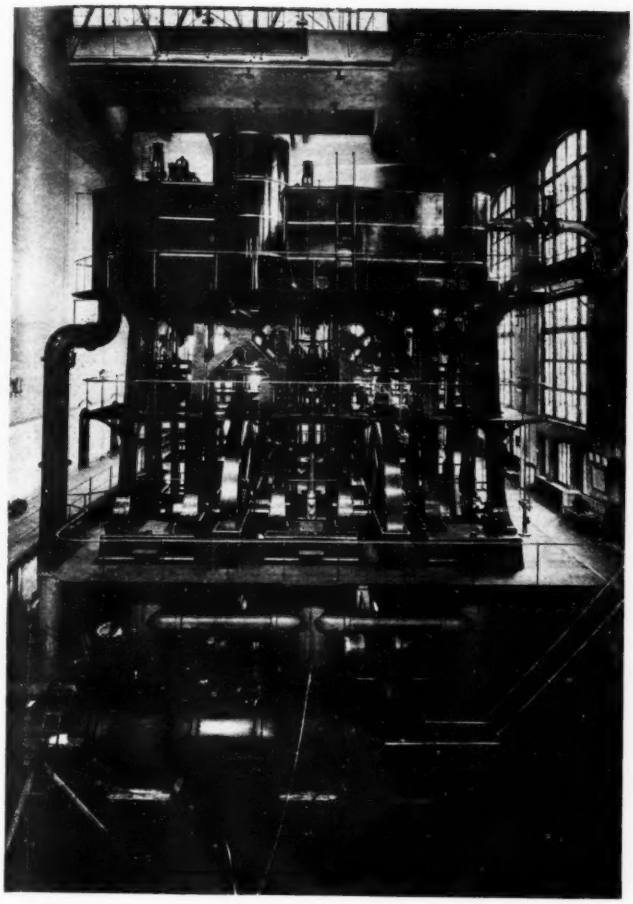
Herron Hill Station.—A secondary pumping station located at Center Ave. and Dithridge St., rebuilt in 1897, contains two 5 M.G.D. and two 6 M.G.D. vertical triplex pumping engines, and two gas-fired boilers. This station delivers water to Herron Hill and to Bedford Reservoirs.

Herron Hill Reservoir.—A secondary reservoir, located on Herron Hill in the University district, completed in 1880, and relined in 1921. Its capacity is 11.5 M.G., depth of water 23 ft., and its supply is received from Herron Hill Station.

Bedford Service, through Herron Hill Station and Bedford Reservoir (elevation 1,094 ft.), supplies a congested residential and small mercantile district adjacent to the Point district of the Central City between approx-



Ross Pumping Station—The Raw Water Pumping Station, Which Delivers the Allegheny River Water to the Filtration Plant



A 20,000,000 Gal. Pumping Unit Installed in Aspinwall Station

imate elevations 920 and 1,030 ft., containing a population of about 22,000.

Bedford Reservoir.—A secondary reservoir, located on Bedford Ave. at Ledlie St., completed in 1850. Its capacity 2.7 M.G., depth of water 9 ft., and its supply is received from Herron Hill Station.

Lincoln Service, through Lincoln Station, taking its supply from Highland No. 1 primary service, and pumping to Lincoln Tank (elevation 1,279 ft.), supplies a small residential section, known as the Lincoln district, in the northeasterly portion of the Central City, between approximate elevations of 1,000 ft. and 1,250 ft., containing a population of about 6,000.

Lincoln Station.—A small secondary pumping station, located at Park Ave. and Dearborn St., completed in 1895, contains two 1.1 M.G.D. electrically driven centrifugal pumps.

Lincoln Tank.—Is a secondary tank of 200,000 gal. capacity, located at the eastern boundary of the City.

Allentown Service, through Mission Station, taking its supply from the low service system, and pumping to Allentown Tanks (elevation 1,294 ft.), supplies the high residential section of the South Side, between approximate elevations of 900 ft. and 1,260 ft., containing a population of about 55,000.

Mission Station, a secondary pumping station, located on Mission St., near South 18th St., completed in 1912, contains two 7 M.G.D. vertical triplex pumping engines and two boilers.

Allentown Tanks.—Three secondary tanks, located in Grandview Park, completed in 1895, have a combined capacity of 2.5 M.G.

McNaugher Service.—Through Howard Station, taking its supply from the Low Service System, and pumping to McNaugher Reservoir (elevation 1,211 ft.), and to Spring Hill Tanks at the same approximate elevation, supplies a residential district of the North Side between approximate elevations of 900 ft. and 1,240 ft., containing a population of about 63,000.

Howard Station.—A secondary pumping station, located at Howard and Elmira Sts., re-equipped in 1928, contains two 9 M.G.D., and four 3 M.G.D. electrically driven centrifugal pumps. This station supplies water to McNaugher Reservoir, Spring Hill Tanks, and to Brashear Reservoir.

McNaugher Reservoir.—Is a secondary reservoir located at Lafayette and Biggs Aves., completed in 1928, consists of two circular concrete units of 5.5 M.G. total capacity.

Spring Hill Tanks, two secondary tanks, located on Erk Way, completed in January, 1929, have a combined capacity of 1 M.G., and are cross-connected with McNaugher Reservoir.

Brashear Service.—Through Howard Station, pumping to Brashear Reservoir (elevation 1,374 ft.), supplies the high residential district of the North Side between approximate elevations of 1,240 ft. and 1,380 ft., containing a population of about 6,000. This is the highest service in the city.

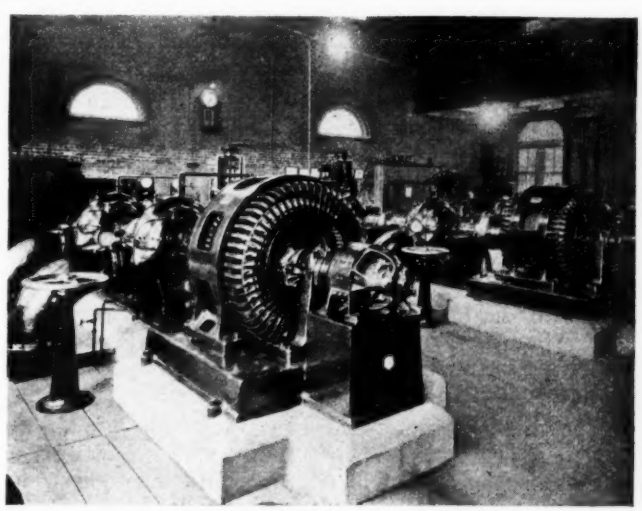
Brashear Reservoir.—A secondary reservoir, located on Montana Ave. at the northerly boundary of the city, is a concrete "T" wall type, containing 11 M.G., at 25 ft. depth of water.

Brashear Reservoir, McNaugher Reservoir, and the new Spring Hill Tanks, supply the district served by Greentree, Lafayette, Montgomery, and old Spring Hill Tanks, all of which have been abandoned.

Plant Data Summarized.—The following is a summary of plant data as of Jan. 1, 1931:

Average daily pumpage raw water	135 M.G.
Distribution mains, 2 in. to 66 in.	828 miles
Rising mains, 8 in. to 96 in.	21 miles
Hydrants in service	7,693
Valves in service	19,737
Service connections	108,573
Water meters in service	47,500
Average domestic pressure	76 lb.

The foregoing notes have been taken from a book prepared by the late Erwin E. Lanpher, who was managing engineer of the Bureau of Water at the time of his death on Jan. 18, 1930. J. H. Kennon is the present managing engineer.



Two 9,000,000 Gal. Daily, Motor Driven Centrifugal Pumps Installed in Howard Pumping Station in 1928

FILTRATION PLANTS

A Section Dealing with Their Design, Construction and Operation

Conducted by JOHN R. BAYLIS, Associate Editor
Physical Chemist, Bureau of Engineering, Chicago, Ill.

Prepare for Algae Troubles

IT is believed that more than one-third of our public water supplies are troubled with algae growths at times. In fact, the ratio for the larger cities is nearly 100 per cent if we include occasional slight occurrences. Troubles from microscopic organisms might be divided into two general classes: (1) tastes and odors, and (2) interference in the operation of purification works. The public is interested largely in the tastes and odors but the water works operator may be more concerned with filter bed clogging than anything else. It is the purpose of this article to discuss only briefly the troubles produced by microörganisms, and then to offer suggestions as to how such troubles may be lessened or eliminated.

Tastes and Odors Produced by Microörganisms.—The tastes and odors imparted to water by microörganisms are due to compounds given off by the organisms, both when they are alive and when they are dead and decomposing. Such taste-producing compounds usually exist in solution, and in most instances cannot be removed by filtration. Tastes and odors are thought to be due largely to oils liberated by the organisms. Whether oils or other compounds, it is evident that some organisms almost invariably impart objectionable tastes and odors to the water if they are present in fairly large numbers. The tastes and odors are described as being aromatic, grassy, fishy, pip pen, ripe cucumber, etc. Different organisms produce different kinds of tastes or odors.

Waters Likely to Produce Algae Growths.—Algae are found growing in almost all kinds of waters. Being dependent upon sunlight, they will not grow extensively in highly turbid water, but this is about the only limitation for water exposed to sunlight. Many forms of organisms are found growing abundantly in the reservoirs of the New York City water supply where the water is very soft, and these same forms are frequently found in reservoirs where the water is very hard. There may be a slight tendency for water rich in certain mineral constituents to favor the growth of microörganisms, but a high mineral content is certainly not an essential. Carbon dioxide and sunlight are the main requirements, and practically all water used for domestic supplies contain carbon dioxide. It is not necessary for the water to contain free carbon dioxide, for various forms of algae grow abundantly in the Great Lakes waters where there is little or no free carbon dioxide. The organisms have the power of utilizing the half-bound carbon dioxide, and any water containing free carbon dioxide or bicarbonates will grow algae.

The animal organisms, as a rule, depend upon the vegetable organisms, or certain forms of organic matter for their food and will not grow if this food is not present. The vegetable organisms, however, have the power of forming organic compounds from carbon dioxide and the other necessary elements, which are usually present in the water in some available form. Sunlight brings about the formation of the organic compounds in a manner not yet understood by chemists. At least the chemist is not able to take carbon dioxide and certain other elements and make some of the organic compounds produced by the sunlight. The sunlight also is limited in that life is necessary and it is only a multiplication of life that takes place. Some might think if microscopical organisms were kept from getting into the water there would be no growths. This is true, though it is impossible to have a reservoir exposed to the sunlight without organisms getting into the water.

There are references in the literature that water treated with lime will prevent algae growths. This may be true where the water is treated to the extent that caustic alkalinity is present, but water so treated is not used very extensively for potable supplies. In general, it might be said that any water treated to the extent that it is in the form most suitable for drinking and other domestic uses will support abundant algae growths if exposed to the sunlight.

Waters from Rivers and Small Streams Not Likely to Contain Many Microörganisms.—As a rule it is not necessary to give special treatment to the water from most rivers and small streams to prevent microscopical growths if the water is only a few hours in open reservoirs in passing through the treatment plant, though the growths are sometimes so abundant along the sidewalls of the reservoirs as to give trouble. Where the water is pumped from the river or other stream to a storage reservoir of one or more days supply before it goes to the treatment plant, as is the case at Louisville, Ky., Cincinnati, O., and a few other cities, microörganisms frequently grow abundantly in these storage reservoirs whereas they will not grow in the streams supplying the reservoirs due to the high turbidity of the water. It is doubtful if much is gained by the storage in some of the cities if the only consideration is lessening the load on the treatment plant. On several occasions Louisville, Ky.,[1] has dredged some of the sediment from the bottom of the storage reservoir to mix with the water going to the treatment plant. This increased the turbidity and produced a heavier and more rapidly settling coagulation, which settled out a large percentage of the microörganisms than otherwise would have been the case.

Filtration May Reduce the Taste and Odor.—Filtration may, and usually does, reduce the offensive tastes and odors imparted to water by microörganisms, but they are not completely elininated in most instances. The public naturally expects the purification process to make the water clear, free from bacteria, and palatable; and while there is no difficulty in making the water clear and sterile, the elimination of objectionable tastes and

odors has not been so simple. It is only recently that progress has been made along this line. A few years ago aeration was about the only treatment given the water to reduce tastes and odors, and while this did considerable good at many places it cannot be regarded as being satisfactory except in a few instances where the taste or odor is never very bad. Filtration removes the organisms and prevents further liberation of the objectionable compounds. In addition to this there is almost invariably a reduction of the tastes and odors in passing through the treatment process even though no special treatment is given the water for taste removal. This reduction, however, even when combined with aeration is not a solution of the taste problem.

Two Methods Available for Preventing Microscopical Troubles.—Two methods are available for the prevention of troubles caused from microörganisms in water supplies. The organisms may be prevented from growing, or both the organisms and the objectionable compounds they produce may be removed from the water in the filtration plant. For some supplies, it is cheapest to prevent microscopical growths in the storage or impounding reservoirs, whereas for other supplies it may be quite difficult to prevent the growths. Even where tastes and odors are not produced it becomes a question as to whether it is cheaper to treat the water in the impounding reservoirs to prevent growths or to give the water some special treatment prior to filtration to prevent filter clogging. There are only a very few cases where microörganisms grow abundantly in the water that the taste of the water is not affected. Where the water is not filtered, as is the case for New York, Boston, Chicago and Milwaukee, the problem of preventing tastes from microörganisms is not an easy one. In distribution or balancing reservoirs there is only one satisfactory solution of the problem, and that is to prevent the growth. It is believed unwise to construct unusually large reservoirs of this type. The fire insurance companies would like cities to have fully a week's supply in distribution reservoirs, but to comply with this desire requires the construction of very large reservoirs, which, in addition to being expensive, frequently causes a deterioration of the quality of the water.

Covering Reservoirs Will Prevent Algae Growths.—As stated, algae require sunlight, consequently if the water is stored in the dark such organisms will not grow. There are a few types of organisms that will grow in the dark, such as crenothrix and other members of the same group, but it is only occasionally that water supplies are troubled with such organisms, especially if the water has been filtered. The storage of water in the dark would be quite expensive where large reservoirs are necessary, and it has not been customary to cover reservoirs or basins where there is a fairly long storage period. It is believed economy to cover any reservoir holding the purified water where the storage is less than about two days, though recent developments in the treatment of water with chlorine or chloramine to prevent microscopical growths may make this unnecessary where the main reason for covering is to prevent organisms growing in the reservoirs.

Many of the smaller towns and cities obtain their water from wells. When the water comes out of the well, it is very pure and needs no treatment in most instances. Almost invariably the water is pumped or run from the wells into storage tanks or reservoirs before it is run into the mains, or a least part of it is run into the tanks or reservoirs. Unless these tanks or reservoirs are covered they become breeding places for microöorganisms, principally algae. Usually the most satisfactory procedure is to cover the tank or reservoir, unless in some cases it is essential to have very long storage. Then it may be more economical to leave the reservoir open and treat constantly to prevent growths.

Treatment for Small and Large Reservoirs—and Treat the Water Coming from Large Reservoirs.—There is no certain size reservoir where it may be said to be cheaper to treat the water in the reservoir to prevent growths if the size is smaller, or to let the organisms grow and treat the water coming from the reservoir to remove the objectionable products produced by microscopical growths if the size is larger. In general, it probably is cheaper to keep the algae from growing in the reservoir if the storage period is less than one month, and if it is longer it may in many instances be cheaper to let the organisms grow in the reservoir and treat the water to remove the organisms and such objectionable tastes and odors that they produce. There, of course, will be conditions where it will be cheaper to prevent growths in the reservoirs even though the storage may be several months, and there probably are other conditions where it may be desirable to treat the water coming from the reservoir where the storage period is only one to two weeks. What should be done is influenced by several factors and no general rule is applicable to all conditions. The water may not be filtered after storage, and if it is desirable to avoid water containing an abundance of microörganisms going into the water mains, the only thing that can be done is to treat the water in the reservoir.

It is evident that it is not practical to treat very large bodies of water. For cities like New York and Boston that have no filtration plants, yet have large storage reservoirs, it is impossible to keep the water free from microörganisms, though they may be materially reduced by treatment in smaller reservoirs just before it goes to the mains. With the ever increasing demand for purer water, such a procedure is not entirely satisfactory. It seems that a city confronted with a similar situation should look forward to improvements that will enable the water works operators to furnish the public the pure and palatable water they so greatly desire at all times and under all conditions. Most of the cities located along the shores of the Great Lakes obtain their water from the lakes. These lakes may be considered enormous storage reservoirs. Certainly a section of such a large body of water cannot be treated to prevent microscopical growths. It may be possible to construct impounding reservoirs whereby the lake water could first be pumped into the reservoir and treated so as to kill the microörganisms and let them settle out before the water goes to the filtration plant or into the mains. Where there is a filtration plant it probably is much cheaper and more satisfactory to make provisions in the filtration plant for handling water containing an abundance of microörganisms, and to give the water a special treatment for removing tastes and odors, than to construct impounding reservoirs of such size that the organisms can be killed and settled out in passing through the reservoirs.

Reservoirs Should be Constructed with a View of Keeping Microscopical Growths at a Minimum.—More attention should be given to provisions for the control of microscopical growths where reservoirs are necessary than has been the practice heretofore. As stated, the public is becoming more and more exacting in their demands for palatable water, and all water supplies should be constructed so that tastes and odors of all kinds may be prevented, or eliminated in the treatment process. Large reservoirs may be necessary to insure

an adequate supply, but where this is not the main consideration it usually is not economy to construct very large reservoirs to aid in the purification process. The most turbid waters are now being treated and handled satisfactory by processes where the water is passed through the plant within 12 to 24 hours.

If considerable storage is desirable to insure an adequate supply, the reservoir should be constructed so there will be a minimum of shallow areas along the shore line. In fact the filling-in of shallow areas with material excavated from within the reservoir may be desirable in some instances. The idea is to make the ground surface slope quite rapidly to fairly deep water. There, of course, is a limit to what may be expended for such purposes, but the designing engineer should have in mind the desirability of keeping microscopical growths to a minimum where large storage reservoirs are essential.

Copper Sulfate Treatment

There are two methods of killing microörganisms in water. One is to treat with copper sulfate and the other with chlorine or chloramine. Under some conditions it is better to use copper sulfate, but under most conditions chlorine is to be preferred. Where the water is passed through a large storage or impounding reservoir prior to filtration, and it is desirable to keep the organisms to a minimum in the reservoir, it is usually cheaper to use copper sulfate. Some raw waters may be so high in organic matter and would consume so much chlorine that such a treatment would be costly. There is doubt in the minds of many as to the advisability of the frequent use of copper sulfate for fear that it may be injurious to health. The writer has never thought there was any danger of copper sulfate poisoning one when used in small quantities yet he would not recommend that it be used continuously where an appreciable amount of copper would reach the consumers.

It is not believed desirable to treat water highly with copper sulfate, even occasionally, where the water will reach the consumers within less than 24 hours. Where possible, the time under such conditions should be several days or until practically all the copper has disappeared from the water. A few cities treat their reservoirs with copper sulfate from one to several times during the year, usually waiting until the microörganisms become abundant before treating. This is not a very satisfactory procedure, for it merely improves a water that is bad only to let it get bad again before treating. Systematic treatment at intervals that prevent the organisms from starting to increase is the most desirable procedure. Just how frequent the application should be, there is not much specific information. Weekly applications very likely will keep the growths in check under most conditions, and there are waters where a monthly application might suffice.

Application of Copper Sulfate to Water.—The usual practice is to put a certain amount of copper sulfate in a gunny sack, tie the sack to a boat, and row back and forth through the water until the desired amount of copper sulfate has been added. The boat should travel over as much of the area of the reservoir as possible, the lines followed being fairly close together. The attempt should be to dissolve a proportionate amount of copper sulfate in all parts of the water, except that it might be desired to have it much more concentrated along the edges. It is evident that the copper sulfate is not uniformly distributed in the water at first, but it probably is only a matter of a few hours until diffusion and currents in the water due to the wind or other causes will produce a uniform mixing. Where the edges of the reservoir are very shallow for some distance from the shore, it probably is better to make the copper sulfate in solution and apply with a spray somewhat as used for spraying paint.

The National Copper Co. has issued a bulletin written by Dr. Hale on "The Use of Copper Sulfate in Control of Microscopic Organisms." It is stated that the customary procedure is to travel parallel courses 20 to 100 ft. wide for large reservoirs, and a zigzag course may be used for small reservoirs. This may seem like a somewhat haphazard method of applying chemicals to water, and it probably results in the loss of much of the material, yet it produces fairly good results. In a few instances copper sulfate has been added constantly, over a certain period, to the water flowing into a reservoir or from one reservoir to another. Such a procedure has been used at New York City[2], in which the water was treated as it passed from the Ashokan to the Kenseco reservoir. This should give more uniform application of the copper sulfate, though there are only a few places where such a procedure is applicable.

A few cities attempt to prevent excessive growths of microörganisms by treating the water along the edges of the reservoirs where the growths are most abundant and make no attempt to treat all the water. This is about all that may be done for very large impounding reservoirs. Such large reservoirs are almost invariably formed by constructing a dam across a river, small stream or ravine. In most instances there will be areas in the reservoirs where the water is fairly shallow for some distance from the shore. Such places are ideal breeding places for algae. The application of copper sulfate to the shallow places may do much to keep the number of organisms fairly low in the reservoir. The shallow areas should be surveyed, the extent of the area where algae grow abundantly determined, the amount of water within the area calculated, and the area marked off on a map or staked off in the reservoir. Knowing the amount of water to be treated, the desired amount of copper sulfate can be added, either by dragging bags suspended from a boat or by a spray. As these areas are usually only small portions of a large reservoir an over-application of the chemical will not harm the water though it might be wasteful of chemicals.

Amount of Copper Sulfate to Use.—The amount of copper sulfate necessary to kill microörganisms depends upon the kind of organisms, and probably to a certain extent upon the character of the water. The temperature may have an effect, for Hale[3] states that about twice as much chemical is required in winter as in summer. Tables showing the amount of copper sulfate necessary to kill the more commonly found microörganisms are found in several articles. The first work of this kind in the United States was done by Moore and Kellerman. Moore discovered in 1901 that copper sulfate was effective in killing spirogyra in watercress beds. Moore and Kellerman[4] later published two bulletins giving extensive experiments on the use of copper sulfate to kill microörganisms. Many who treat water with copper sulfate use the tables prepared by these authors as their guide.

Caird[5] was one of the first to make extensive use of copper sulfate in treating water in reservoirs to reduce microscopical growths. He used this material in the reservoirs of the water supplies of Elmira and Middletown, N. Y., and Norwich, N. J. Table I has been prepared from data given by Caird.

The impounding reservoir at Elmira was constructed

TABLE I—COPPER TREATMENT OF IMPOUNDING RESERVOIRS

Reservoir	Capacity Million Gallons	Water in Reservoir Million Gallons	Copper Sulfate Added P.P.M.	Organisms Per C.C. Before Treatment	Organisms Per C.C. After Treatment	Days After Treatment Before Testing
1904						
Elmira, N. Y.	113	90	1.33	....	..	....
Elmira, N. Y.	113	90	.40	....	..	....
Middletown, N. Y.						
Monhegan Reservoir	296	250	.33	43	1	14
Highlands Reservoir	560	495	.44	73	5	6
Shawangunk Reservoir	434	350	.46	53	5	10
1905						
Mohengen Reservoir	.....	255	.32	34	1	7
Highlands Reservoir	.....	451	.35	52	4	12
Shawangunk Reservoir	.....	317	.50	44	4	20

in 1870, the timber and surface soil being removed. The water was treated with 1.33 ppm. of copper sulfate, June 25, 1904. Before treatment, the water had a strong fishy odor. The principal growths were anabaena and asterionella. Anabaena disappeared within 36 hours and asterionella within 84 hours. Immediately after treatment pollywogs began coming to the surface in large numbers and dying within about 1 hour. No frogs were killed, but numerous small black bass and two large ones, 10 large bullheads, and numerous small sunfish were found dead. The second treatment was given Nov. 3, 1905, at which time synedra, asterionella, anabaena and volvox were present. Only 0.4 ppm. of copper sulfate was used in the second treatment. The temperature of the water was 1.0 degrees C. No fish were killed this time and no odor was detected 6 days afterwards. No fish were killed in the treatment of the water in the reservoirs at Middletown and Norwich.

Huff and House[6] used much smaller quantities of copper sulfate than was recommended by Moore and Kellerman in treating Lake Vadnais of the St. Paul, Minn., water supply. They concluded that one part of copper sulfate in 12 million parts of water was sufficient to kill spirogyra, cyclotella, and most of the cyanophyceae. They also state that it will practically eliminate melosira and some of the protozoa. A list of a number of organisms that will be killed by the addition of one part of copper sulfate in 10 million parts of water is given.

Mahlie[7] gives a table showing that the amount of copper sulfate necessary to kill microörganisms ranges from 0.07 to 10.0 ppm. He also discusses the effect of copper sulfate upon algae and objections to its use. "It is not definitely known just what happens to the algae when copper sulfate is used. In all probability the copper attacks the outer cell wall in the same manner that it attacks cellulose, and liberates the cell contents. Microscopic examination after the algae have been treated appears to confirm this, for the cell contents appear to have been scattered and changed in color.

"All of the copper sulfate applied is not used up or consumed by the organisms, but part of the copper is precipitated out by the bicarbonates of calcium present in the water. For this reason, it is seldom that any copper ever gets into the water in such condition as to be consumed by the people. We have used some rather heavy doses of copper sulfate at Fort Worth and in no case could we ever find any traces of copper in the water after filtration."

Mahlie is of the opinion that one part per million of copper sulfate is sufficient for most waters.

Chase[8] describes the use of copper sulfate in the Cape Pond Reservoir of the water supply of Rockport, Mass. The capacity of the reservoir at high water mark is about 182 million gallons. The water was treated with 0.28 ppm. of copper sulfate on May 22, 1922, which was followed by a second application of 0.60 ppm. on May 27. There was no great reduction of microörganisms following the first application. The accumulated copper sulfate in the reservoir as a result of the second treatment amounted to 0.88 ppm., according to Chase. If Mahlie's statement is correct, it is likely that all or nearly all of the first application disappeared before the second application. Chase gives a list and the number of various kinds of fish killed following the second treatment. There were more than 1,800 dead fish of all kinds removed from the reservoir, many of them ranging from 6 to 13 in. in length. The addition of 0.5 ppm. of copper sulfate Nov. 3, 1922, to this same reservoir reduced the number of microörganisms from about 11,000 per cc. to about 600 on Dec. 4. The organisms died out gradually. Chase states that the application of suitable amounts of copper sulfate in May, 1922, so checked the microscopic growths as to keep the number materially less during the summer and early fall than any previous summer. The effect of the copper sulfate wore off about the middle of the fall of 1922 and the usual fall increase occurred. The amount of copper sulfate required to kill the organisms in Cape Pond was between 0.5 and 0.9 ppm., about 0.7 ppm. probably being sufficient.

Gilkison[9] used copper sulfate to keep the algae growths along the reservoir sidewalls of the Quindaro Reservoir under control. The first attempt was to drag a sack of copper sulfate through the water along the sidewalls, but this was not successful. It was then added to the water along with the alminum sulfate. A start was made with 0.25 ppm., and this was progressively increased to 1.5 ppm. There was no apparent action on the walls until the concentration of copper sulfate reached 1.0 ppm., and at that concentration the algae at the end of the basin where the material was being applied were killed. It required 1.5 ppm. to clear the far wall. The alkalinity of the water was about 185. Gilkison thinks that most of the copper sulfate was lost by the action of the alkalinity of the water. No fish were killed even though the reservoir contained catfish, carp, perch, drum, shad and buffalo. Later the basins were treated by drawing down the water about 6 ft. and applying a 5 per cent copper sulfate solution direct to the wall with a paint spray.

Favorable results are reported by Cameron[10] in controlling algae growths in two impounding reservoirs supplying Bucyrus, O., by applying copper sulfate at regular intervals from May to October, 1925. From 0.25 to 0.40 ppm. of copper sulfate was used. It was applied to the water by dragging burlap sacks of the material behind a boat. In 1926, a different procedure was used. The need for treating the water was determined by the filter runs. When the runs began to get shorter the reservoirs were immediately treated. This produced as good results as treatment at regular intervals the previous year. Cameron concluded that the 0.25 to 0.40 ppm., which was used to treat the reservoirs, was sufficient if applied at proper intervals. He states that it is essential that the treatment be made often enough to keep well ahead of the growths so that unpleasant tastes and odors are not produced as an after-effect of the treatment.

Hale,[3] in a bulletin issued by the Nichols Copper Co., gives the most comprehensive treatment of the use of copper sulfate in the control of microscopical growths. Various methods of applying the copper sulfate to the water are explained and illustrated. Table II is part

of a table given by Hale. He states that the data were obtained from publications by Moore and Kellerman, Whipple, various other sources, and from personal experience.

Frequency with Which the Water Should Be Treated.—There are differences of opinion as to how often the water should be treated with copper sulfate. Some are of the opinion that the effect of one treatment lasts for a period of weeks, or several months. It, of course, requires some time for algae which have been killed out to again increase to large numbers; but should we wait until they have increased to large numbers before applying another treatment? The writer is of the opinion that the use of copper sulfate should be more to prevent growths than to kill the organisms after they have grown to large numbers. In this case it might be desirable to give continuous treatment to some waters, treatment once a week in reservoirs where there is frequent replacement of the water, and treatments less often in the larger reservoirs. Where the chemical is applied before the organisms increase to large numbers, it is believed that lesser quantities will be required than is necessary if the organisms are in abundance. The addition of 1.0 ppm. of copper sulfate every two weeks to reservoirs where the water is stored from several days to about two weeks should be sufficient to keep the growths to a minimum for most waters.

TABLE II—COPPER SULFATE REQUIRED FOR TREATMENT OF DIFFERENT ORGANISMS

Organism	Taste and Odor	Parts Per Million Copper Sulfate	
Diatoms			
Asterionella	Aromatic, geranium, fishy	0.12	—0.20
Cyclotella	Faintly aromatic		
Fragilaria		0.25	
Melosira		0.33	
Navicula		0.07	
Nitzchia		0.50	
Synedra	Earthy	0.36	—0.50
Stephanodiscus		0.33	
Tabellaria	Aromatic, geranium, fishy	0.12	—0.50
Chlorophyceae			
Cladophora		0.50	
Closterium		0.17	
Coelastrum		0.05	—0.33
Conferva		0.25	
Desmidium		2.00	
Draparnaldia		0.33	
Eudorina	Faintly fishy	10.00	
Entomophora		0.50	
Hydrodictyon	Very offensive	0.10	
Microspora		0.40	
Palmella		2.00	
Pandorina	Faintly fishy	10.00	
Raphidium		1.00	
Scenedesmus		1.00	
Spirogyra		0.12	
Staurastium		1.50	
Ulothrix		0.20	
Volvox	Fishy	0.25	
Zygnema		0.50	
Cyanophyceae			
Anabaena	Moldy, grassy, vile	0.12	
Aphanizomenon	Moldy, grassy, vile	0.12	—0.50
Clathrocystis	Sweet grassy, vile	0.12	—0.25
Coelosphaerium	Sweet grassy	0.20	—0.33
Cylindrosphermum	Grassy	0.12	
Microcystis		0.20	
Oscillaria		0.20	—0.50
Rivularia	Moldy, grassy		
Protozoa			
Bursaria	Irish moss, salt marsh, fishy		
Ceratium	Fishy, vile	0.33	
Chlamydomas		0.50	
Cryptomonas	Candied violets	0.50	
Dinobryon	Aromatic, violets, fishy	0.18	
Euglena		0.50	
Glenodinium	Fishy	0.50	
Mallomonas	Aromatic, violets, fishy	0.50	
Peridinium	Fishy	0.50	—2.00
Synura	Cucumber, muskmelon, fishy, bitter	0.12	—0.25
Uroglena	Fishy, oily, cod-liver	0.50	—0.20
Crustacea			
Daphnia		2.00	
Schizomycetes			
Beggiatoa	Very offensive decayed	5.00	
Cladothrix		0.20	
Crenothrix	Very offensive decayed	0.33	—0.50
Sphaerotilis, natans	Very offensive decayed	0.40	
Fungus			
Leptomitus		0.40	
Saprolegnia		0.18	
Miscellaneous			
Chara		0.10	—0.50
Nitella, flexilis	Objectionable	0.10	
Potamogeton		0.30	—0.80

Where the capacity of the reservoir is not more than one to two days supply, and the water is flowing through instead of balancing the pumping load as is the case for certain distribution reservoirs and tanks, usually the organisms do not grow in great abundance in the water, though the sides of the reservoir or tank may have such a thick growth as to warrant some kind of treatment. It is not believed advisable to use copper sulfate in such reservoirs if the water leaving the reservoir goes direct to the consumers. Some water systems use very little of the water in the balancing or distribution reservoirs and tanks, and depend upon fluctuating the pumping load to take care of the variations in the consumption. Such reservoirs serve more as an emergency supply than a storage that takes care of the varying consumption. Copper sulfate may be added to reservoirs of this type if practically none of the water containing copper reaches the consumers. It has been stated that copper sulfate usually disappears from the water quite rapidly and there should be little or none left in the water several days after treatment.

Distribution Reservoirs the Most Difficult to Handle.—Any treatment applied to distribution reservoirs where the water is flowing first into the reservoir and then out should be done with precaution. Too frequent treatment of the water in such a reservoir with copper sulfate might increase the copper content to a point above what may be considered safe for human consumption. It might be stated that there is no specific information as to how much copper is required to become injurious. In the absence of such information the water works should adopt the safe course and not supply water with more than an extremely small amount of copper. The writer would not recommend the continued use of water containing more than 0.1 part per million of copper (Cu) where it is known that the copper is derived from the application of copper sulfate. It is true if the water in the reservoir is not frequently displaced not much of the water containing copper gets into the distribution mains and this tends to make the water less dangerous.

The systematic application of copper sulfate to the water in reservoirs or tanks connected directly to the distribution system should be done only where it is possible to keep close check on the amount of copper in the water. It can be assumed when algae grow in the water that there is no appreciable amount of copper in the water, but as previously stated the policy of waiting for the algae to grow before treating is not a very good one. The writer is of the opinion that chlorine or chloramine is a more satisfactory method of preventing

growths in reservoirs where the water is likely to be used shortly after treatment.

Chlorine for Algae Control

The use of chlorine for algae control is becoming more extensive. It probably will never be used in large impounding reservoirs, but for smaller reservoirs it is a very effective means of preventing microscopical growths. There is no objection to the occasional use of copper sulfate where the copper largely disappears from the water before it reaches the consumers, but as stated, it should not be used where the water may be drank within a few hours after the copper sulfate is applied. We know that chlorine is not poisonous, and that the only objection to its use is where a taste is produced, consequently we do not fear that an over-application will be injurious to the human system. Now that the addition of ammonia to the water prior to the application of chlorine largely eliminates the chlorinous tastes, the use of chlorine in small reservoirs and tanks will likely become the prevailing practice within the near future.

Conditions Under Which Chlorine Is Best Suited for Preventing Microscopical Growths.—Very few surface waters are used for water supplies without filtration and chlorination, and while the use of chlorine for algae control is not limited to treatment plants, it is more likely to be used at such plants because nearly all such plants now use chlorine for sterilization and the operators are familiar with its use. Several plants have reported a material lengthening of the filter runs by the addition of chlorine to the water prior to or at the same time of the coagulant. The Wallace & Tiernan Co. recently advertised that the filter runs at Barberton, O., were tripled by prechlorination. The use of chlorine in the several balancing or distribution reservoirs at Baltimore, Md., was started in 1925, and while its use was largely for sterilization it kept the algae from growing. Chlorine in the form of hypochlorite of lime was applied daily to some of the reservoirs.

Cohen[11] found that chlorine gave very good results in preventing the growth of algae in a reservoir at Mexia, Tex. The water is obtained from two sources, a spring and a well. It was chlorinated at both sources, and this prevented heavy algae growths in a large storage reservoir located in the city. Complete freedom from algae growths was not attained. About 1.0 ppm. of chlorine was applied to the water. Cohen also reports the successful use of chlorine for algae control at Lufkin, Tex. Approximately the same amount of chlorine was applied as was used at Mexia. Chlorine has been used both for the prevention of microscopical growths and for the removal of tastes produced by microörganisms in some of the reservoirs of the New York City water supply.[3 12 16]

Mangun[13] reports the successful use of chlorine to keep the algae under control in a distribution reservoir at Kansas City, Kan. Prior to 1927, copper sulfate was used, the procedure being to add it to the reservoir Saturday evenings when the reservoir was filling up. As a rule no water flowed out of the reservoir until Monday morning, 36 hours later. By this time the concentration was greatly reduced. Mangun states that the reservoir was chlorinated regularly about three times a week from July to September, 1927. The chlorine was fed into the incoming water during the night, beginning about 8 P. M., and feeding at a rate that would give the desired amount by 6 A. M. the following day. One part per million was a representative dosage. This would show a residual of about 0.2 ppm. at the perifery of the reservoir at 6 A. M. and about 0.02 at the center. At the time of the first application of chlorine the reservoir contained 13,000 synedra per cubic centimeter, and the suddenness of their disappearance after the chlorine treatment was almost magical, according to Mangun. In discussing the paper, Carl Wilson of Los Angeles reports an occurrence of protococcus in the Ascot Reservoir in which copper sulfate did not kill the growth. The reservoir was cut off and superchlorinated. This killed all the growths.

The Ammonia-Chlorine Treatment for Algae Control.—The writer is of the opinion that the ammonia-chlorine treatment to prevent algae growths will become very extensive within the near future. In most instances the water in distribution reservoirs can be successfully treated at one point, that is, where the chlorine is applied for sterilization. It is possible to add an amount of chlorine to the water, without the production of chlorinous taste, that will maintain a residual chlorine for several days in the water in the warmer months and somewhat longer in the colder months. Where the water is not stored unduly long in the balancing or distribution reservoirs and tanks, sufficient chlorine can be added to the water at the point where it is treated for sterilization to maintain a residual chlorine on the reservoirs or tanks to prevent microscopical growths. This should, in most instances, be a more satisfactory procedure than frequent application of chlorine or copper sulfate to the water in the reservoir. Not only are the microörganisms kept under control, but the maintenance of a residual chlorine constantly in the reservoirs or tanks is a good protection against possible contamination.

Siems[14] gives a very favorable report on the use of the ammonia-chlorine treatment for preventing algae growths at Greenville, Pa. Algae grew in the clear water reservoir nearly all the time. The practice prior to the use of the ammonia-chlorine treatment was to cut off the reservoir, add copper sulfate, and then turn back on to the system after a few days standing. The use of ammonia was started in March, 1930. 1.37 ppm. of chlorine was being applied to the effluent of the filters at the time the ammonia was started. This was being reduced to a residual of about 0.05 ppm. at the effluent of the clear water reservoir. The reservoir held 4.5 days supply. Ammonia was added at the rate of 1.1 ppm. In two days the residual chlorine at the effluent of the reservoir increased to 0.6 ppm. The ammonia and the chlorine were then both set at 0.6 ppm., which gave a residual of 0.4 ppm. of chlorine at the reservoir effluent. When the algae season began in April the chlorine was increased to 1.5 ppm. and the ammonia to 1.0 ppm. This gave a residual of about 0.5 ppm. of chlorine at the effluent of the basin.

Raab[15] relates an unsuccessful attempt to reduce tastes and odors at Minneapolis, Minn., by the use of the ammonia-chlorine treatment, the tastes and odors probably being due to microörganisms. The water had such a bad taste that few could drink it. Various ratios and various amounts of ammonia and chlorine were tried, but the treatment did not reduce the moldy color. Raab states that some of the park wells were lined with cars for a distance of two blocks, the people going to the wells for the more palatable drinking water. The chlorine was finally raised to as high as 2.0 ppm. with no reduction in taste and odor. After 8 days of unsuccessful odor removal the ammonia-chlorine treatment was abandoned and the water prechlorinated with 2.16 ppm. of chlorine at the Fridley plant. This gave a marked improvement, and it was then tried at the Columbia Heights plant with equal success.

Hale[16] gives another very good treatise on the control of microscopic organisms, referring particularly to methods used in treating the water for New York City. He describes the use of both copper sulfate and chlorine. The amount of chlorine necessary to kill the organisms ranges from 0.3 to 1.0 ppm., except in a few instances certain organisms such as the crustacea require a heavier dosage.

Mention also should be made of the article by Stover[17] on troubles in the operation of mechanical filters at Louisville, Ky. Attempt was made to improve conditions by adding hypochlorite of lime to the filter beds. This treatment was not successful. Additional coagulant also was tried, but was not successful. Copper sulfate was then tried, from 1.2 to 1.7 ppm. was added to the water in the second section of the sedimentation reservoir. This materially increased the filter runs. The beneficial period lasted from 8 to 19 days.

No attempt has been made to refer to all the literature on treatments to prevent algae growths. In fact, the literature records only a very small percentage of the water supplies using some kind of treatment at times to prevent the growth of microörganisms. It is believed that in the articles to which reference has been made one may get an idea of prevailing practice in the control of microscopical growths in the reservoirs and tanks of our public water supplies.

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Prize Designs for Elevated Steel Water Tanks

The international competition, sponsored by the Chicago Bridge & Iron Works, of Chicago, George T. Horton, President, to develop an aesthetic improvement in the character of elevated water tanks, was brought to a conclusion April 20th at a final meeting of the judges, at which time the following awards were made:

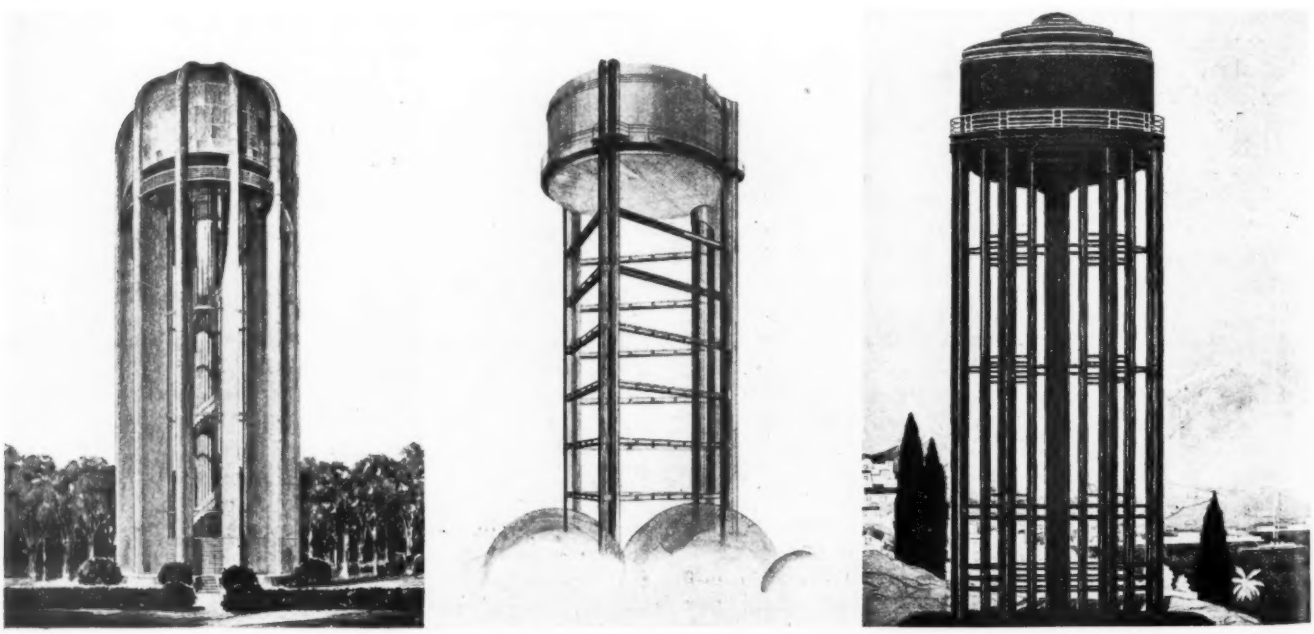
First prize of $2,000 to Eugene Voita, 837 N. Lorel Ave., Chicago, Ill.; 2nd prize of $1,000 to F. D. Chapman and C. M. Goldman, Associated, 207 Main St., Evanston, Ill.; 3rd prize of $500 to Howard W. Vader, 333 N. Michigan Ave., Chicago, Ill.

Honorable mentions, carrying a prize of $100 each, were awarded to the following:

Donald A. Blake, 7721 Colfax Ave., Chicago, Ill; Geo. A. Hossack, 10 S. LaSalle St., Chicago, Ill.; Ossip Klarwein and Fritz Hoger, 22 Hertogestr., Hamburg, Germany; Mary Ann E. Crawford, 2820 Cambridge Ave., Chicago, Ill.; Samuel E. Homsey, 31 Concord Ave., Cambridge, Mass.

The jury of award consisted of R. W. Zimmerman, Architect, Chairman, Howard L. Cheney, President of Chicago Chapter, American Institute of Architects, and George T. Horton.

The competition, the execution of which covered a period of 20 months, was conducted by Albert M. Saxe, Architect, as professional adviser. There were 691 applications to participate, resulting in 152 final presentations of drawings.



Prize Winning Designs for Elevated Water Tank. The Design at Left Was Awarded First Prize; the Design in the Middle Second Prize; and the one at the Right Third Prize

The Operation of Trickling Filters

Part I Dealing with the Theory and Operating Practices. Part II Covering the Interesting Phases of Operation Difficulties Will Appear in the June Issue

By MORRIS M. COHN
Sanitary Engineer, Department of Public Works, Schenectady, N. Y.

THE trickling filter is the Dr. Jekyl and Mr. Hyde of the sewage treatment works. Its expanse of sleek-looking stone acreage is neat, the rows of distribution nozzles stand like so many well-trained soldiers in parade formation, the sewage sparkles as it sprays out into the summer sunlight; the stretches of concrete pipe galleries cut through the stone beds with scientific precision and the concrete walk make a fitting border for the entire picture. The filters are the showplace of the plant. In performance, the well-operating filter backs up the good impressions given by its physical structure. There is no other treatment device that has so well stood the test of time. Its successful results and ease of operation make it difficult to replace even in the face of the development of newer oxidizing mechanisms.

Here the trickling filter ceases its well-mannered and respectable existence and takes on the more sordid characteristics of Dr. Jekyl. The trickling filter has brought much grief to plant operators as a result of this double life. The spread of odors from filters in an age of most sensitive nasal reactions, the development of flies in an age when winged insects are entirely unwelcome and the tendency for the beds to develop unsightly physical conditions in an age of aestheticism, has done much to retard the development of the trickling filter.

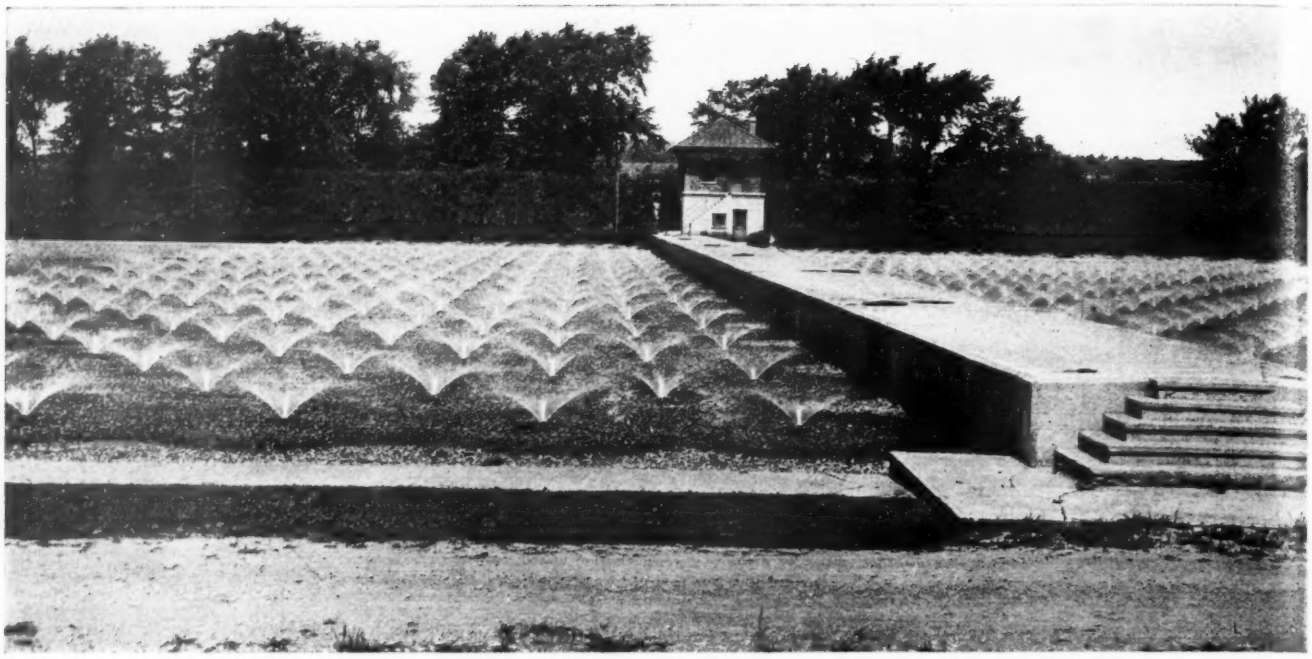
In short, the trickling filter is a good performer but a bad actor. The future of this efficient secondary device is in the hands of the plant operators of today. Intelligent and faithful adherence to known principles of control and the development of new means for correcting the filters, weaknesses, will do much to keep them in the good graces of the citizens who live in view of and, incidentally, in smelling and fly-travel distance of, the modern sewage-works.

What Is a Trickling Filter?—With a terseness most creditable and most characteristic of their scientific missions the joint committee of the American Society of Civil Engineers and the American Public Health Association define a trickling filter as "an artificial bed of coarse material, such as broken stone, clinkers, slate, slats or brush, over which sewage is distributed and applied in drops, film or spray, from troughs or dippers, moving distributors, or fixed nozzles, and through which it trickles to the under-drains giving opportunity for organic matter to be oxidized by bio-chemical agencies." That is a neat definition and leaves but little for the imagination.

While we are interested in operation of these oxidation beds, we are somewhat in the same predicament of the little youngster who simply must take his new watch apart to see what makes it run. We are compelled to investigate, quickly, the construction of the trickling filter in order to better understand what makes it trickle. If we get our parts into place mentally, better than the little fellow does the springs and wheels of his clock, the theory of operation will become clearer.

The definition mentions the three main portions of a filter, the distribution system, the filtering medium and the under-drainage system. A hasty review of the construction features of these filter elements will meet our needs. The distribution system consists of the device for regulating the sewage dose to the beds such as the siphonic apparatus, traveling distributors or butterfly valves, the piping main to carry the sewage to the filter unit, the laterals stretching out onto the bed area and the

Dosing Tank and Trickling Filters at Schenectady, N. Y., Treatment Plant



Distribution Nozzles Like Well-Trained Soldiers in Parade Formation; Sewage Spray Sparkling in the Sun, a Concrete Pipe Gallery Cutting Through the Beds with Scientific Precision

actual devices such as nozzles, dash plates or traveling applicators for the dispersion of the sewage out onto the stone acreage in the form of spray, drops or film. The main function of the entire distribution system is to spread the sewage onto the available bed surface evenly in the pre-determined cycle of dosage.

The media consists of crushed rock such as trap, granite, limestone or other suitable, hard natural formation, or of coke, slag or other less-used materials. The question of filtering material is now considered of major importance in assuring satisfactory life and desirable operation of trickling filters and exhaustive studies on various materials are being made by committees sponsored by scientific bodies. The size of the medium used is somewhat dependent on the local conditions of loading and influent character but, in general, it can be said that a too large stone provides too little filtering surface and a too fine stone is subject to rapid clogging. The depth of stone used depends also upon local conditions. The question of optimum bed depth is still much debated but there appears to be a tendency toward discouraging the excessive depths as too costly in the face of the slight increase in oxidation afforded. Most installations lie between 5 and 10 ft. in depth.

The under-drain system consists of a concrete floor upon or into which is built a series of drainage troughs or tiles to carry the filtered sewage to the effluent conduit. Many types of under-drain systems are in vogue but the function of all is to get the oxidized effluent out of the filter with the greatest ease. The under-drain system also provides for the movement of air currents through the beds.

Functions of a Trickling Filter.—The trickling filter is a secondary or oxidizing device. Its use presupposes some preliminary treatment of the sewage flow, which ordinarily consists, among other steps, of partial clarification by sedimentation. The sewage, after this preparatory treatment is distributed onto the filter surface by means of the nozzle or other spray devices and percolates or trickles down through the bed, coming in intimate contact with the filtering stone. The media supports an amorphous gelatine coating in a well-seeded and efficient unit and this gelatine or "schmutz-decke" in turn acts as the habitat for an abundant growth of aerobic micro-organisms. The settling solids still remaining in the partly clarified tank effluent are removed mechanically by the filtering action of the stone. The large quantities of colloidal matter adhere to the gelatine surfaces by adsorption and absorption and much truly dissolved material is directly absorbed by the same film growths. The nitrifying bacteria, living in the film, by oxidation convert the nitrogenous material from the less stable ammonia forms to the more stable nitrites and nitrates. Much bacteria are removed from the sewage by the action of the filters, in much the same manner as the solids themselves taken from the treated liquor. The resulting filter effluent is highly oxidized and is not subject to the type of putrefaction to which the applied clarified sewage is susceptible. One of the most important functions of an operating filter is the periodic storage and sloughing-out of the solids gathered from the applied sewage. A filter that did not intermittently drop these solids would be no more prone to good health than would the human who stored up solids and did not have the ability of discharging the wastes of his existence.

Operation of Trickling Filters.—Satisfactory operation of trickling filters, from the viewpoint of the sewage works operation, is the manipulation of the units in such manner as to produce maximum of nitrification during all seasons of the year. Present day demands require more than the production of a stable effluent from a sewage works. The discharge of this type of effluent into the diluting stream may please the state health officials and make the Izaak Walton Leaguers happy, but the sewage plant operator has still a third class to satisfy. The operation of trickling filters in closely populated sections will be permitted only so long as the units can be maintained without the undue production and broadcasting of odors and flies. Further, the filters will remain an addition to the beauty and cleanliness of the plant only so long as the bed surfaces are kept free from pooling, mosquito breeding and weed growths and the nozzles are kept cleared of clogging materials. There is no sorrier looking sight than the trickling filter partly submerged with inky water, with many of the nozzles in incomplete display due to clogging and with other noz-

zles spouting geysers of sewage from spindle-less domes.

Nitrification.—Stripped of all its incidental merits, the ability of the trickling filter to nitrify the sewage applied to it at high operation rates is its only excuse for existence. The oxidation in the beds is a true index of the efficiency of operation. This efficiency of conversion of the organic nitrogen to the more stable forms of the nitrogen cycle is dependent on many conditions, such as temperature, character of applied sewage, rate of filter loading, condition of bed surfaces and underdrains and degree of bed unloading and effectiveness of distribution of sewage over the entire stone area. With all of these variables, it is difficult to generalize about nitrification efficiency. It can readily be seen that since the oxidation efficiency of filters comes as a result of bio-chemical agencies, that the efficiency of a trickling filter will improve with a rise in atmospheric and sewage temperatures. It may be scientific heresy to state that summer efficiency need not be higher than winter efficiency but, that, nevertheless, is true. Sufficient interference with normal oxidation may occur during the months of normally high efficiency to bring the summer nitrification far below the winter level. At Schenectady, the past year has given complete illustration that a well-operating filter need not lose its effectiveness despite marked cold weather. As a result of constant flooding of the beds during the past summer, the quantity of oxidized nitrogen present in the filter effluent during July, August and September was around 5.0 p.p.m. Surprisingly, the beds have maintained sufficient oxidation efficiency during the trying months of November, December, January and February to produce quantities of nitrates and nitrites fully 150 per cent of the summer quantities. This ability of the filters to withstand the rigors of a northern winter so well, indicates that the possibilities of trickling filters have not yet been fully understood. The reasons for this marked performance will be taken up below.

The orthodox opinion, that bed efficiency is greater for lower sewage loadings than for excessive dosages is also open to some question in the light of many superloading tests carried out throughout the country. At Schenectady, repeated tests indicate that increased loading during the summer season results in no decrease in nitrification efficiency. During the past summer, a bed loaded to 150 per cent of normal actually showed slight increases in efficiency over a control bed dosed at normal rates of 3.0 m.g. per acre per day. It is now definitely understood that the strength of the incoming sewage rather than the quantity treated, determines the capacity of the filter units. The ability of filters to withstand greater loading will, if substantiated by further tests, reduce the cost of construction of these secondary treatment units.

This appears to be the age of contradictions and even the opinion that complete under-aeration of filters is necessary to efficient operation has been questioned. The experiments with a filter with underdrains incapable of receiving atmospheric oxygen, as carried out at State College, Pennsylvania, showed satisfactory nitrification still to obtain. It has been decided, nevertheless, that the breathing action of the filter was permitting the entrance of surface air into the complete body of the filter. At Schenectady, the old theory of desirable under-aeration is borne out by the fact that when the under drainage system of the filters is sealed by abnormal river elevations, the efficiency of oxidation drops markedly.

Solids Removal and Unloading.—The trickling filter will not turn out the sparkling drinking water expected by some lay people, but it will remove much of the turbidity-producing colloidal matter from the influent and turn out a comparatively transparent effluent.

Despite this removal of the delivered solids, the trickling filter effluent will average equally as high or higher in suspended solids than the influent. Nevertheless, the solids emitted from the beds are distinctly different than the solids carried by the clarified sewage sprayed onto the bed. The disgorged solids are humus-like, they have more stable characteristics but still they contain much worm and insect life that make them somewhat difficult to handle satisfactorily. Thus the filter acts as an agent for converting unsettleable colloids into a settleable type of humus. It appears reasonable to assume, therefore, that complete secondary treatment will provide for the settling-out of these solids from the filter effluent before depositing this liquid into the diluting stream.

The accumulation of solids in the filter interferes with the free passage of air and sewage down through the media and thus reduces the nitrification efficiency. It is, thus, essential that the beds be cleared of the solids deposit in order to prevent a cessation of the true functions of the units. In the light of present day knowledge the idea that a heavily gelatinized stone bed produces the best results is fallacious. Given a satisfactory, thin film on the entire body of the media, the clean bed produces the most stable forms of nitrogen. It seems reasonable to assume from this that the bed that is constantly unloading a steady stream of humus-like solids with the effluent will continue to maintain its efficiency at a uniform level instead of showing an efficiency curve with summer crests and winter troughs. The clean condition of the Schenectady beds produced by chlorination of the filter influent several years ago resulted in high winter efficiencies. In like manner, the regular disturbance of the bed solids and the consequent steady heavy unloading resulting from last summer's periodic flooding of the units for fly control has, no doubt, contributed much to the high filter efficiencies of this past winter. Can it not be said, then, that the clean filter is the efficient filter and that operation methods that produce steady unloading without the destruction of normal aeration are desirable?

The unloading solids produce in the trickling filter effluent a decrease in stability and an increase in the biochemical oxygen demand resulting from the putrefaction of these solids. With satisfactory removal of these solids in humus tanks, the final effluent stability should be but little affected by this phenomenon.

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What 100 Per Cent Meterage Did for San Antonio

The following note is taken from the report of the Water Works Board of Trustees of San Antonio, Tex., for the period ending June 1, 1930:

"No water system can ever be a complete and perfect success unless it is 100 per cent metered, and San Antonio's system is now 100 per cent metered; the cost to complete it being approximately $400,000, and due to this fact, unnecessary waste of water has been eliminated, leakages detected, and a more equitable table of rates maintained. As a result, since the purchase of the water plant by the city, the rates to all consumers have been reduced 5 per cent, the sprinkler fire protection rate has been reduced 25 per cent, substantial reductions in rates have been made to consumers outside the city limits, and a more liberal interpretation of the requirements as to the commercial rate has been inaugurated."

Charges for Sprinkler Fire Protection

A Method for Making an Equitable Charge for the Service That Will Afford Proper Remuneration to Water Departments

By L. R. HOWSON

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THERE are as many varieties and methods of making charges for sprinkler fire protection service as there are plants supplying the service. This lack of uniformity has given rise to much difficulty.

Fundamental Rules for Rates.—It is believed that an equitable basis for determining a fair rate for fire protection service must be governed by the fundamental principles governing equitable rates in general, among which are:

(a) Every consumer of the utility service should pay his fair share of the total income.
(b) No service should be furnished to any consumer at less than cost, for this inevitably results in raising the costs of service to all other consumers.
(c) No charge for service should be greater than the value of the service to the user.
(d) No charge for service should exceed the cost of securing equal service from another source.

Classification of Operating Costs.—The various costs incidental to the operation of a water utility may be classified under two headings:

1. Those which are incurred due to the utility's ability to meet demands as they arise, more commonly termed "readiness to serve," and—
2. Those costs which accrue due to the water actually delivered, commonly called "consumption charges."

The readiness to serve charge must cover all costs such as interest and depreciation, reading of meters, etc., which depend for their amount upon the consumer's ability to take even though for more or less extended periods of time he may be taking no water. The consumption charge must fairly cover the cost of pumping, treating and delivering the water, including all charges which vary in proportion or with respect to the use.

Sprinkler fire protection service is essentially a "readiness to serve" water works function just as public fire protection. In the ordinary city of 50,000 to 100,000 people, approximately 25 per cent to 35 per cent of the total income should equitably be received from the public for fire protection service. For this relatively large percentage of the gross income, the service requires in actual water used only from ¼th to 1/6th of 1 per cent of the pumpage. It is evident, therefore, that no rate based upon a consumption basis has any real bearing on the problem of fixing a fair charge for municipal fire protection service. The same conclusion applies to sprinkler service.

Automatic sprinkler fire protection service, although effective 90 per cent of the time in putting out fires with the use of less water than would probably be required from the public hydrants, nevertheless requires the assistance of the public fire protection system about 10 per cent of the time, at which times the sprinkler load is in addition to the demand for the public hydrants, plus the domestic use at the time. At such times, the demand of the sprinkler system clearly increases the maximum demand upon the water system for which the mains, pumps, etc., must be designed. Unless there is some charge for this capacity, the fixed charges on it must be distributed through the rate schedule to the other consumers, thus violating the second fundamental principle of an equitable rate schedule as above stated.

A Specialized Extra Service.—The demand nature of sprinkler fire protection service is apparent when the manner of the operation of the sprinklers is considered. At time of fire in a sprinkler protected property, the nozzles open without warning and the automatic fire protection system actually appropriates the necessary capacity in pumps, mains, etc. The operation of automatic sprinkler fire protection is under private not public control, is a specialized extra service requiring expenditures by the water department in order to supply the service and, therefore, should be paid for by those requiring it. There should be some compensation included to cover inspection costs which experience has demonstrated is necessary to prevent surreptitious use of what should be purely a "readiness to serve" service.

An equitable charge must lie somewhere intermediate between the cost of the service to the water department and its value to the consumer. The cost to the department is represented by a "readiness to serve" charge on the sprinkler connection in the same proportion to the total "readiness to serve" of the entire system as the ability of the sprinkler service to draw water is to the total ability, of all services to draw water. Thus if a water system comprises the equivalent of 10,000 ¾-in. services, and its total readiness to serve charge is $50,000 per year, a 4-in. sprinkler service should pay as a minimum approximately $\frac{28}{10{,}000} \times \$50{,}000$, or $140 per year.

How the Maximum Charge Would Be Indicated.—The maximum charge would be indicated by the saving in insurance premium less the fixed charges on the installation cost. Assuming a $10,000 sprinkler installation in a 5-story building 100 ft. by 200 ft. and served by a single 6-in. connection from the water main with 1,000 sprinkler nozzles and further assuming a saving in insurance cost of $2,000 per year, the maximum that the consumer could afford to pay the water department would be approximately $1,000 per year.

Possibly such a large charge would violate fundamental principle (d) as the alternative to a connection with the municipal water supply system is the service from an entirely independent source such as a cistern or well with the necessary pumps, tanks, supervision and operation.

Summary.—The foregoing discussion of sprinkler fire protection service and charges for it may be summarized as follows:

1. Automatic sprinkler fire protection service is a specialized service, the control of which is wholly outside of either the utility furnishing the service or the public fire protection system.
2. The ability to furnish adequate sprinkler fire protection service involves costs to the water department.
3. Sprinkler service in common with all other utility services, should at least pay the costs caused by it.

4. Private fire protection service is no more warranted at public expense than private watchmen or other similar services.
5. Fire protection service, including automatic sprinkler protection, is almost entirely a "readiness to serve" function and the charges should be computed as such.
6. Charges for automatic sprinkler fire protection service should be based on the size of the pipe connecting the sprinklers to the water system and not on the number of nozzles installed as is frequently done.
7. While an equitable rate for automatic sprinkler fire protection service is purely a matter of local determination and no specific charge is therefore possible for universal application, it is believed that a fair range of charges probably falls within the following:

   For 2-in. connection from $ 40 to $ 60 per year.
   For 3-in. connection from $ 75 to $125 per year.
   For 4-in. connection from $125 to $250 per year.
   For 6-in. connection from $250 to $550 per year.

The above range will in general result in payments for automatic sprinkler fire protection service which will remunerate the water department for the expenditures involved in furnishing the service and at the same time, enable the protected property to have the protection desired at a cost much less than the saving in insurance premiums. These figures being closer to cost to the water department than to the value of the protection to the private property owner, should encourage the installation of better fire protection through automatic sprinkler installations.

Acknowledgment.—The above is an abstract of a paper presented April 28 before the Illinois Section of the American Water Works Association.

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Varves—What Are They?

In the section "What's New in Science" in the Los Angeles Times of April 12, Mr. Ransome Sutton gives the following interesting description of clay varves:

"The newest and most important word in geology, paleontology, ethnology and archeology today is "varves." Too new to be in textbooks or dictionaries, one has to go to technical papers to learn its meaning. Varves are thin layers of clay deposited by glacial waters in ancient lakes, which tell what has happened since the glaciers began to melt. Like rings on trees, varves tell of storms, droughts, the retreat of "rivers of ice," the warpings of lands, and cycles of change which can be projected into the future as a basis for prophesying what is likely to happen upon this aging earth. To fix the dates of events in time, varves are better than tree-rings, because some of them were laid down thousands of years before the oldest existing Sequoias were seeds. As accurately as the Rosetta Stone enabled scholars to read the hieroglyphics of ancient Egypt, varves enable geologists to decipher the dead language of the elements.

"A Swedish geologist, Baron Gerard de Geer, first discovered the meaning of varves half a lifetime ago. He is still alive, but blind. He wore out his eyes translating a few chapters of earth's story. Instead of promptly announcing his discovery, he tested it, and that took years. But now we are told, in an Associated Press dispatch from Phoenix, Ariz., that: 'A new method of reading the earth's age, by counting certain peculiar layers in its crust, just as tree-rings are read, is in preparation here.'

"The dispatch refers to Prof. A. E. Douglass, of the University of Arizona, who has undertaken to fit his remarkable tree-ring calendar into the time-scale revealed by the varves.

"Before Dr. Douglass became interested in varves, Halbert P. Gillette studying data obtained directly from Prof. de Geer, found confirmation for his theory that cyclonic storms and earthquakes come in cycles and are caused by magnetic forces exerted by the sun and planets. Varves and tree-rings alike show the same cycles.

"How were these thin lips of clay, which tell such an ancient story so truly, created?

"Picture a canyon filled with ice, as in Greenland today. Throughout the Ice Age, lasting many thousands of years, we are told that the ice sheets over most of Canada and our own northern states averaged more than one mile thick. North America had over half of the ice. Six million square miles of land in the northern hemisphere are still under that ice. Many more thousands of years will elapse before the Ice Age ends up north. The advance of the ice king was worse than that of Attila: every living plant or animal that did not retreat was killed. The glaciers, having huge boulders imbedded in them, gored out deep basins which were destined to become fresh-water lakes.

"Now picture what happened when the world began to turn warmer. From under every gleaming glacier streams of water surged, carrying all sorts of detritus down to deltas formed by themselves. Then as the melting glaciers backed up, the pits they had dug and the basins behind the deltas filled with melted snow. In some countries the water would be saturated with clay. And when the waters found their levels, the clay would slowly settle and form a milky layer over the bottom of the basins. That would be the beginning of a varve. It took both a winter and a summer to complete a varve.

"Throughout the Ice Age, there were summers and winters the same as now, save that both were colder. During summers, the waters did a rushing business, but a lighter business during winters. Hence the layer of clay deposited each year shows two lines or striations—one being the heavy deposit of summer's swollen streams, the other the lighter deposit of winter's smaller streams. Year after year, in this manner the varves were laid down, like shingles on top of one another.

"In no one lake is the record complete. For the earth's crust was undergoing violent change: relieved of the weight of ice, some lands teetered up and teetered other lands down, causing streams to change courses and seek new outlets. Lake Passaic in New Jersey, according to Chester A. Reeds, was warped upward edgewise —412 ft. on one side and 345 ft. on the other. Piecing together varves from five different lakelets, Reeds obtained 45 ft. of clay containing a continuous series of 2,550 varves—laid down during the 2,550 years it took the ice-front to retreat up the Hackensack Valley.

"Dr. De Geer has already matched the story of Sweden's varves into the varve-story of North America and learned many startling facts: for example, that Niagara Falls was born as the Ice Age ended at that particular place—only about 10,000 years ago.

"In the same way that tree-rings tell of years, or cycles, of rainfall and drought, varves tell of years and cycles of weather changes, because thick varves mean warm weather and thin varves colder weather. Since Baron de Geer has scaled time backward some 17,000 years beyond the birthdays of our oldest redwoods, meteorologists may now check their curves and project them far into future time. And if Dr. Douglass succeeds in linking his tree-ring scale into the longer chain of varves, he will deserve a Nobel Prize."

SEWAGE DISPOSAL WORKS

A Section Dealing with Their Design, Construction and Operation

Conducted by A. ELLIOTT KIMBERLY, Associate Editor
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Status of Pea-Canning Waste Treatment

IN many sections of the country, the wastes produced in canning peas cause serious stream pollution and, as corrective measures, treatment of varying degrees of thoroughness is necessary in the interests of public health, riparian rights and the recreational uses of streams. The character and the intensity of pea waste pollution and the degree of treatment required, if any, depend, of course, upon given conditions, particularly the flow of the receiving stream.

Intensive studies of pea-waste treatment, under industry auspices, originated in Wisconsin in 1925; similar tests were made in New York, from 1927 to 1929, inclusive. To date, a number of Wisconsin pea canners have constructed waste treatment plants.

These studies are incident to efforts of state departments of health to improve stream conditions and are inherent in the viewpoint that industrial waste disposal is a problem for the industry itself and not for any individual member thereof. This program, inaugurated in 1924, aims therefore to establish the underlying principles of remedial treatment and has developed remedies of much wider practical applicability than is true of past efforts of the individual pea canner, directed toward solving his own particular problem.

A recent publication by the New York State Department of Health[1] summarizing results of tests at Albion, from 1927 to 1929, and experiences in practice in Wisconsin since 1925, suggests a summary of current progress in the art of pea-canning waste treatment. Especially do such data appear of timely interest and importance, since the start of the 1931 pea pack is only about 60 days distant and construction work should get under way promptly, in order that improvement in stream conditions may cover the entire period of the pack.

Pea Wastes.—The wastes produced in packing peas comprise all of the process water used at the factory, carrying in suspension, whole or broken peas and some pods, and in solution, organic matters of vegetable origin, originating as follows:

1. Cold wash.
2. Continuous blancher discharge.
3. Blancher dump.
4. Floor wash incident to clean-up.
5. Stack or silage liquor or "juice."

Volume and Composition.—On the basis of a 2-line cannery, the Wisconsin studies show that the total volume of waste which requires treatment, is about 100,000 gal. per day, produced at the rate of about 140 g.p.m. The New York figures indicate likewise a flow of 25 gal. per case as 2's.

[1] "The Treatment of Canning Wastes," New York State Department of Health, Albany, N. Y., Division of Sanitation, C. A. Holmquist, director, 1930.

The average waste from pea canning is acid to phenolphthalein, averaging about 300 p.p.m., pH 4.9 and a 5-day BOD of about 1300 p.p.m., ranging during the 1928 pack at Albion, from 380 to a maximum of 1980 p.p.m., the latter representing substantially complete operation of the factory. For the smaller factories at full operation, the evidence suggests that the average BOD is not far from 1500 p.p.m.

The individual wastes vary considerably in organic matter as indicated in the interesting tabulation below, from the New York report. Attention is directed to the fact, that in each instance, the organic matters in the wastes involved in treatment problems are almost entirely in solution.

TABLE I—ANALYSES OF SPECIFIC PORTIONS OF PEA WASTES, 1928

(Parts per Million, Except pH Values)

	SAMPLES COLLECTED JULY 16, 1928			
	Waste from pea washer No. 1	Continuous blancher discharge No. 2	Blancher dump liquor No. 3	Stack liquor No. 4
Total solids, original*	2,843	20,047	24,382	78,312
filtered**	2,535	19,163	23,575	76,148
Loss on ign., original*	2,294	18,176	21,260	63,649
filtered**	2,149	17,315	20,747	61,634
Oxygen consumed	1,260	7,900	9,100	25,600
5-day BOD	3,700	13,815	34,490	57,000
pH	4.4	6.6	6.7	7.2

*Sample as collected.
**Same sample following filtration in the laboratory through filter paper to remove suspended solids.

The explanation of the many instances of marked stream pollution incident to the untreated discharge of wastes from pea production is the fact that the average waste demands from a 2-line cannery, about 2,340 lb. of oxygen per day, based upon an actual flow of about 100,000 gal. in 12 hours and an average 5-day BOD of 1,400 p.p.m. The dilution required to prevent nuisance and to conserve fish life is at least 155 to 1. A stream flow at 21.0° C. of 31.1 MGD or 48.1 sec. ft. is required to supply the demanded oxygen.

Treatment.—The tests made in Wisconsin, beginning in 1925, show the effective removal of organic matters in pea wastes, by the application of lime and ferrous sulphate. The work at Albion, N. Y., shows that the waste from pea canning may under certain conditions, be more or less effectively oxidized by trickling filters. Experiments in New York in 1928, confirm the applicability of chemical precipitation with lime and ferrous sulphate. In view of the considerable quantity of suspended matters carried by these waters, mechanically operated screens are essential as the initial step in waste treatment.

Fine Screening.—For pea wastes, a revolving screen with wire cloth of 40 meshes per inch, having an opening of 0.0160 in. when constructed of 0.009-in. wire, is very satisfactory under practical operating conditions.

Such a screen will average to remove about 20 cu. ft. of screenings per 100 cases of peas as 2's, equivalent to about 80 cu. ft. of screenings per 100,000 gal. of pea waste, or the waste flow from a 2-line cannery. Each square foot of screen will handle about 200 gal. of pea waste per hour, so that 10 sq. ft. of screen area are required per 1,000 cases of peas as 2's. A 2-line plant therefore requires on peas, a screen area of about 40 sq. ft.

The cost of a screening plant for a 2-line cannery is about $1,200. The daily operating costs, including disposal of screenings are about $10 per day.

Chemical Precipitation.—The Wisconsin experiments definitely indicate that under careful operation, the application of about 3.25 lb. of ferrous sulphate and 7.25 lb. of lime per 1,000 gal. of waste will reduce the biochemical oxygen demand approximately 75 per cent. It is not feasible to permit the accumulation of sludge in the settling tanks, owing to the contamination of the supernatant waste by resolution of organic matter and it is strongly indicated that clarifiers should be included in a chemical precipitation layout for peas wastes, under a continuous plan of operation.

A plant suggested for a 2-line cannery, providing precipitation with ferrous sulphate and lime, consists of a screen and on a continuous flow plan, a Dorr clarifier with a detention period of 2 hours, based upon a flow assumed as two-thirds of a maximum flow at 140 g.p.m. The plant includes 3,000 sq. ft. of underdrained sludge beds. Such a plant, exclusive of the cost of the screening equipment, operating upon a continuous basis, with Dorr clarifiers, is estimated to cost about $2,800 and about $1,000 less, when operated on a fill and draw basis.

Costs of operation with lime at $20 per ton and ferrous sulphate at $40 per ton, including labor, power and maintenance, are estimated at about $13.70 per day, on a continuous flow basis, or about $14.25 on a fill and draw plan of operation.

The conclusions drawn during the tests in New York, on the chemical precipitation of pea wastes are that the application of from 7 to 10 lb. of lime and from 3 to 5 lb. of ferrous sulphate per 1,000 gal. of waste, produces, under proper mixing, a readily settleable floc, effect the removal of from 40 to 50 per cent of the 5-day BOD and produces a practically clear effluent.

The coagulated wastes may be settled in 2 hours in continuous flow tanks or in 1 hour in fill and draw tanks. The sludge volume is about 10 per cent of the volume of waste treated. The sludge dries rapidly if sufficient lime has been applied to produce a pH in excess of 10.0. Three thousand square feet of sludge bed area are required for each 100,000 gal. of waste per day, based upon a 7-day drying period and the application of sludge to a depth of 3 ft.

The cost of fill and draw plants is estimated at $5,000 per 100,000 gal. of waste treated per 12-hour day and about $5,500 on a continuous flow basis. Operating costs including labor, chemicals, interest and depreciation, are estimated at $30 per day.

Treatment supplementary to the application of coagulating chemicals is essential in many instances. The New York tests suggest final chlorination, equivalent to the removal of about 30 per cent of the residual unstable organic matter. Sufficient chlorine must be added to produce 0.5 p.p.m. residual chlorine, requiring an initial dose of from 8 to 30 p.p.m. The higher dose is doubtless necessary for chemically treated effluents.

The cost of chlorination equipment for a 2-line cannery is about $1,200 and the total daily cost of operation is about $4. Manual control of cylinder discharge may be applicable in some instances at a much lower investment cost.

In general, the New York tests show that chemical precipitation is sufficient only when the final dilution is not less than 25 to 1. It is evident that the pea waste disposal problem cannot be effectively solved in the case of many small receiving streams, unless the process is supplemented by chlorination or by final oxidizing treatment.

Trickling Filters.—As indicated by the New York data, the organic material in wastes from 1,000 cases of peas as 2's per day, is equivalent to the sewage from the population of 2,500. In other words, the population equivalent of waste from a 2-line cannery is about 10,000.

Pea wastes, properly screened, may be oxidized on trickling filters, the rate of treatment on which is dependent upon the available dilution in the receiving stream. When operated at the rate of 0.5 MGAD, such filters remove from 80 to 95 per cent of the 5-day BOD. This treatment is adequate when the final dilution is not less than 5 to 1. Trickling filters operated at the rate of 2.0 MGAD remove from 50 to 70 per cent of the biochemical oxygen demand, a reduction which is entirely adequate when the final dilution is not less than 20 to 1.

Trickling filters should have a depth of not less than 6 ft. and for each 100,000 gal. of waste per working day of 12 hours, an area of 4,300 sq. ft.; at a rate of 0.5 MGAD, the required area is 17,000 sq. ft. In some instances, it is desirable to apply every other day to the screened influent, 100 lb. of lime for each 100,000 gal. of applied wastes, under operation at 2.0 MGAD, or about 100 lb. of lime per each 20 sq. ft. of filter area. This lime dosage prevents the growth of fungi and lessens clogging.

A trickling filter plant, including pumps, fine screens, capacity 100,000 gal. per day, costs about $6,000 under operation at 2.0 and about $20,000 under operation at 0.5 MGAD. Operating costs are $25 and $35 per day on a 2.0 and on a 0.5 MGAD basis, respectively, including labor, power, depreciation and interest on investment.

Treatment Supplementary to Chemical Precipitation.—To reduce the organic matters remaining in settled chemically treated pea waste, studies were made in Wisconsin on the applicability of applying the chemically treated effluents to trickling filters. In a progress report issued in November, 1929, it is stated that a trickling filter, constructed of crushed lime stone 8 ft. deep, will reduce the BOD of settled effluents from chemical precipitation, from 35 to 84 per cent, provided the rate of application does not exceed 3.0 MGAD.

The report makes the very important comment, that about two weeks operation is required before the filter becomes effective. It is evident that bacterial flora and slime must be developed upon the filtering medium and therefore, trickling filters for use in pea waste treatment, should be operated with sewage inoculated water for a period of at least two weeks before the start of the pack.

Stack Liquor.—The vines and pods in pea canning are either stacked or placed in silos. After about 10 days, a juice or waste is produced as a result of marked fermentation, containing from 5 to 20 times as much organic matter as in average waste. The tests at Albion, N. Y., indicate that the stack liquor averages about 1,650 gal. per 1,000 cases of peas as 2's in production.

This strong waste which contains about 78,300 total solids, 63,650 loss on ignition, 25,600 oxygen consumed and 37,000 p.p.m. 5-day BOD, is too concentrated for ordinary treatment and should never be discharged into a stream. In some factories this liquor is caught in a

sump, pumped to tank wagons and hauled away. To reduce this expense, interesting studies were made in New York in 1929, indicating that by the application of 100 lb. of lime per 1,000 gal. of liquor, it is possible to effect a reduction of 83 per cent of the 5-day BOD, thus permitting this liquor to be treated with the main volume of plant wastes. It is very essential in such cases, however, to distribute the discharge of the chemically treated liquor over as large a portion of the operating day as possible.

The construction costs of a stack liquor treatment plant of sufficient capacity for a 2-line cannery is estimated at about $2,000 and includes a coagulation tank operating on the fill and draw basis and sludge drying beds. Daily operating costs are estimated at about $11, including interest and depreciation. There are doubtless cases where the interest on the investment and the operation costs are less than the cost of hauling or other methods of stack liquor disposal.

This treatment produces sludge estimated as 20 per cent of the volume of the stack liquor treated. At a 2-line cannery with a capacity of 4,000 cases as 2's per day, the volume of stack liquor is about 6,600 gal. and the sludge produced from the chemical treatment is about 180 cu. ft., requiring 180 sq. ft. of sludge bed area for the application of sludge to the depth of 1 ft. or an area of 1,260 sq. ft. on the basis of 7-day drying period.

Conclusions From Actual Full Scale Operations.—An index of the practical application of the foregoing principle of pea canning waste treatment, may be obtained from a summary of investigations made by the Wisconsin State Department of Health, from 1926-1929. In 1927, there were seven treatment plants in operation in Wisconsin and during the 1929 pack, at least 13. Chemical precipitation was the final treatment provided at 11 factories; broad irrigation at two.

The investigations show that mechanically operated screens are most advantageous and advisable in practice as the first step in pea canning waste treatment.

Chemical treatment with the quantities previously indicated, will remove from 50 to 75 per cent of the oxygen demand of average pea canning wastes. Thorough mixing and a settling period of 1 hour is required and daily removal of sludge is essential. Fill and draw plants include circular tanks with conical bottoms, having slopes of 45 degrees and provided with quick opening valves to facilitate sludge removal.

It was found that broad irrigation, supplementing screening, is impractical for general application, owing to serious ponding and marked aerial nuisances. Only on exceedingly porous soil is it feasible to dispose of screened cannery waste by broad irrigation.

Trickling filters are useful in the treatment of the settled effluents resulting from the chemical precipitation of pea canning waste and at a rate not exceeding 3.0 MGAD, will remove from 35 to 84 per cent of the residual BOD.

Chemical treatment costs range from 0.34 to 0.78 cent per case of No. 2 cans. Under Wisconsin conditions, the capital cost of such a treatment plant for a 3-line cannery is about $3,500.

Sludge from chemical treatment dries rapidly on sand and has no appreciable odor. It has a fertilizing value of about $3.50 per ton (air dried basis).

Concluding Comments.—As a result of carefully planned tests, under full industry cooperation and control work, during the past five pack-years, knowledge of methods of practical pea canning waste treatment appears to have reached a point where the sanitary engineer is in position effectively to solve a given problem.

The first line of attack is thorough screening, made possible by the use of fine revolving screens, which are so superior to the formerly used fixed screens. The removal of the coarser materials in pea canning waste materially reduces the formation of sludge banks which, incident to their rapid fermentation, extract the oxygen from the supernatant river water and continue so to do, not only at the end of the factory day, but often for weeks after the pea pack has ended.

The choice of treatment is dependent upon stream conditions with respect to the size of the factory involved. Chemicals are useful, but require the continuous or daily removal of sludge and operating costs are generally somewhat higher than when the screened wastes are treated by bacterial oxidation. The removal of organic matters by the use of lime and ferrous sulphate is partial only and where stream flows during the pea pack are insufficient to afford the necessary dilution, marked improvement is possible with supplementary chlorination or by further treatment on trickling filters.

A trickling filter 8 ft. deep substantially reduces the organic matters in screened pea canning wastes. The rate of treatment which controls the cost, is again a factor of available dilution. The New York data appear to offer reliable guides to the solution of any given problem. The efficiency of trickling filters is also limited and again chlorination may often be advantageously considered as supplementary treatment. By its use, not only is there obviously direct oxidation of the residual organic matters, but also a retardation in the rate of oxygen extraction from the stream water, permitting the beneficial effect of reaeration to be in practical effect upon the mixture of effluent and stream water for substantially increased distances below the point of entrance of the treated waste.

Under no circumstances should stack or silage juice be discharged into streams or permitted entrance into the factory drains, unless chemically treated along the lines indicated in the New York studies and under the conditions therein set forth.

Irrespective of the type of treatment used, work should get under way at once, in order to serve the coming June pack and in case bacterial oxidation is planned, at least the partial maturity of the filter should be assured by operating with dilute sewage for at least two weeks prior to the start of 1931 production.

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A 3 1-3 Mile Intake

From 1868 to 1896 the water supply of Erie, Pa., was taken from Presque Isle Bay, originally through an open flume, 640 ft. long, supported by timber piers, and later replaced by an intake pipe, 51 in. in diameter, of brick, wood, and iron construction, extending 975 ft. northwardly from the pumping station at the foot of Chestnut St.

This was abandoned in 1896 and replaced with a 60-in. cast iron pipe, 8,307 ft. long, laid in a trench 13 ft. below the mean level of the water in the bay, with 3 ft. of earth over its top. Begun in 1904 and completed in 1908, an extension of 9,334 ft. of 60-in. steel pipe was added to the end of the cast iron pipe, and carried through the Peninsula into Lake Erie, terminating in a submerged crib 5,100 ft. north of the Peninsula. The crib is 40 ft. by 40 ft. by 19 ft. and has 22 ft. of water over its top at low water level. The total length of the intake is now 17,641 ft. and has a maximum capacity under present conditions of 36 million gallons a day.

An emergency intake valve is located on the bay side of the Peninsula to permit the opening of the intake at that point in case of necessity.

Progressive Water Works Enlargement at Racine, Wis.

An Example of Good Management in Water Works Development—How Plant Improvements Outlined in 1920 Were Built Out of Earnings

By DONALD H. MAXWELL
Of Alvord, Burdick & Howson, Consulting Engineers, Chicago, Ill.

THE municipal water works of Racine, Wis., affords a good example of the practical application of a conservative policy of progressive enlargement of a plant to meet the needs of a growing city and at the same time, building out of earnings. At a time when the country is suffering from deflation following a period of over-activity in many directions, the above example of conservative management of plant expansion becomes particularly interesting. The wise policy

The Filter Plant

which has been consistently adhered to by the Racine Water Board, if more generally followed in water works extension and in other lines of development, would tend to avoid the alternation of feast and famine that is otherwise bound to occur.

Original Plant.—The Racine water works was built by private capital in 1886. The supply was taken from Lake Michigan through a 24-in. intake pipe with crib located in 40 ft. depth of water, 7,000 ft. from shore. The unfiltered water was delivered to the mains by a steam pumping plant located on a narrow lot at the mouth of Root River.

This plant sufficed, with replacements and additions to equipment, until purchased by the city, May 1, 1919. The water had been safe-guarded by hypochlorite sterilization since about 1912.

The capacity of the intake was limited to 5,000,000 gal. per day under direct suction by the high lift pumps, which were located approximately 12 ft. above lake level. The available capacity had been increased in 1899 by means of an intake booster pump which was capable of delivering 9,000,000 gal. per day to the high lift suction well. The booster consisted of a belted engine driven vertical screw pump mounted in a shaft supplied by a bypass from the intake line.

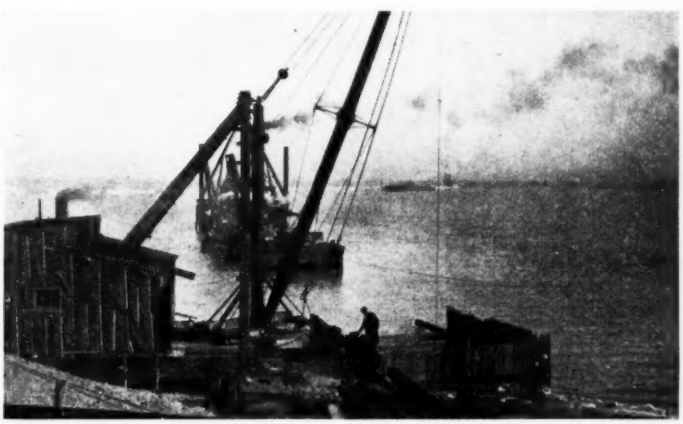
New Booster Pump.—At the time of purchase by the city, the booster pump was in practically continuous service and required to be supplemented. The city in 1920 installed a new booster pump consisting of an engine driven centrifugal mounted in a pit 8 ft. below lake level and drawing water from the old station yard intake bypass tunnel by means of a suction line made by drilling and setting a well casing into the top of the tunnel. This improvement cost approximately $20,000 and insured a capacity of approximately 9,300,000 gal. per day from the old intake.

Development Program.—In the meantime, a general report on plant improvements was made to the city outlining the expenditures necessary to modernize the plant and provide for the expected growth of the following 20 years.

The necessary improvements included an additional intake, a new steam pumping plant and a water filtration plant and accessory work, involving a total estimated expenditure of about $2,000,000.

This work as carried out is now nearing completion nearly 12 years after its inception. It has been carried out progressively in an orderly manner and so far, entirely out of earnings. In the meantime the water supply has been progressively improved in quality and capacity without depleting the city's bonding power or placing any extra burden of interest payment on the tax payers.

During the time that these improvements have been under way, the city has also made substantial progress toward retiring, out of water revenue, the bonds issued to finance the purchase of the plant.

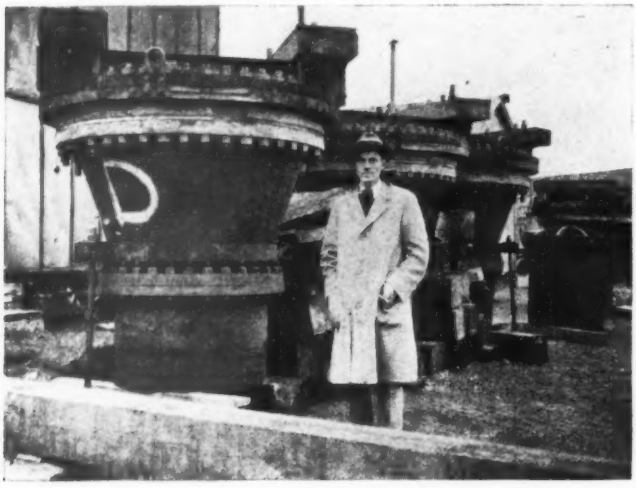


Laying Intake Pipe Shore Shaft Cofferdam at Right

New Plant Site.—Immediately following the general report, attention was given to the selection of a suitable site for the proposed new plant. The old plant site being narrow and bisected by railroad tracks, was not suitable to accommodate the necessary enlarged pumping station and a filter plant. The best available site was selected. It is situated two blocks north of the

old plant and adjoins Racine Harbor near the north breakwater and a public park to the north. The new site is approximately 260 ft. x 950 ft., with a total area of about 5½ acres, and is adequate for the probable ultimate needs of the city.

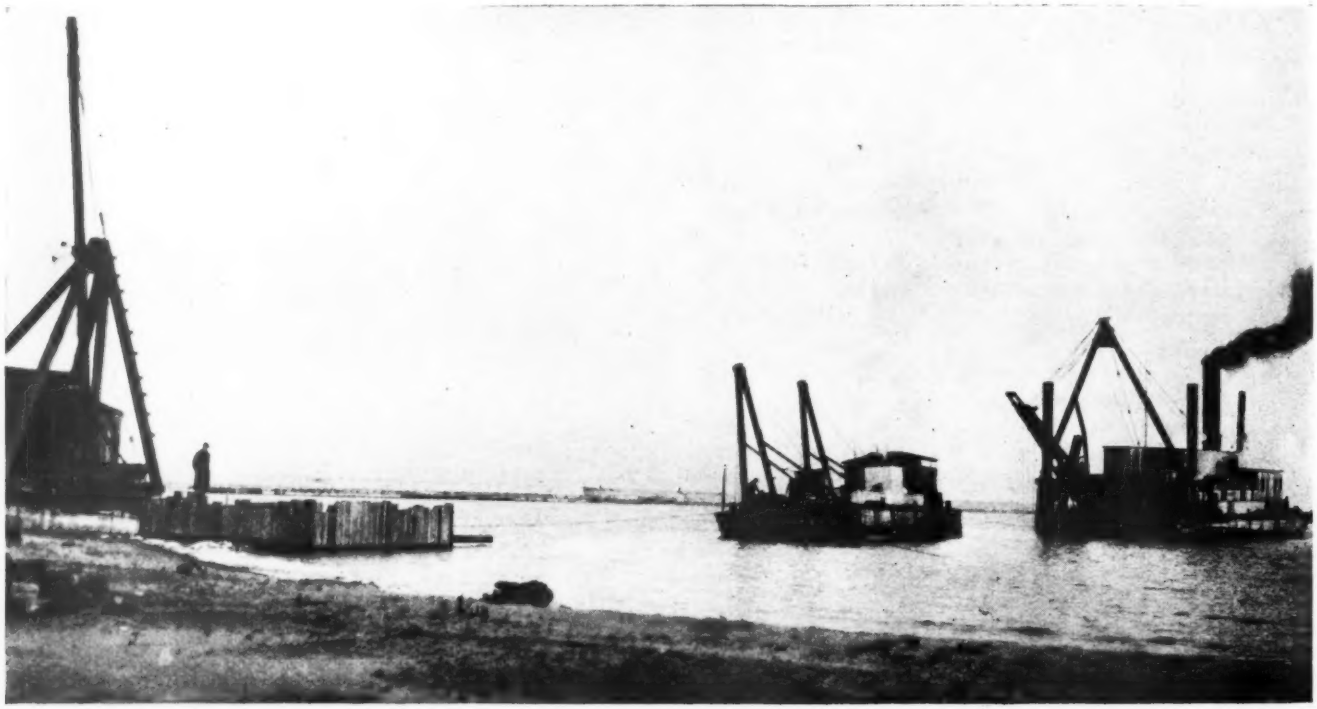
Coagulation Basin.—The most pressing need being for increased supply of water for the emergency of fire, the construction of a new intake was given serious consideration in 1923. Pipe prices at this time were distinctly unfavorable. In order to save money and possibly tide over to a period of lower pipe prices for the intake, the plan was adopted of building the coagulation basin that would be necessary in connection with the future filtration plant, and making use of this basin for reserve storage on the suction side of the high lift pumps for emergency demand in case of fire. A coagulation basin of 1,800,000 gal. capacity was built, equivalent to 4,300,000 gal. per day pumpage rate on the basis of 10 hours storage. The cost complete, including mixing tank, was $87,000. Use of this basin, which was built on the new water works lot two blocks from the main plant, necessitated pipe lines to and from the basin and installing an additional low lift pump operating in tandem with the engine driven booster pump. The total cost of the additional pump and pipe line connections to the new coagulation basin was approximately $67,000.



Emergency Inlets Capped for Pressure Test of Intake

Pipe Barge—Last Section of Intake—60 Ft. of 36-In. Pipe and Tee to Go Under Crib

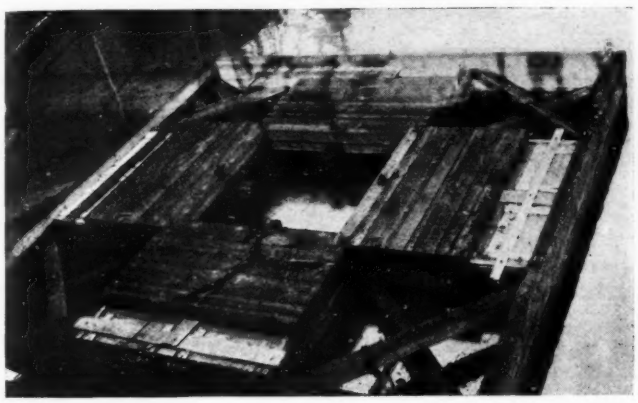
The coagulating basin was put into service as a plain sedimentation basin, being kept full at all times, but equipped with emergency outlet at bottom to permit drawing on the reserve storage for fire service. For about 1½ years, the coagulation basin was used in this way, resulting in a very noticeable improvement in the quality of the water, practically eliminating turbidity even when the lake water was in its worst condition. The city not only benefited by the improved quality of the water, but secured the substantial equivalent of a 45 per cent increase in available supply at a total cost probably less than half what a new intake would have cost at that time.



Pipe Laying Barge and Dredge at Shore Shaft of Intake

Filter Plant.—The filter plant was completed in 1925, designed for an initial capacity of 12,000,000 gal. A low service reservoir was included, in addition to the clear well, making the total available filtered water storage 3,000,000 gal. In carrying out this plan, it was necessary to limit the filter plant to 9,000,000 gal. capacity, owing to conflict with an unexpired leasehold which made unavailable a portion of the property to be occupied by the filters. The additional 3,000,000 gal. capacity was built two years later.

Operation of the plant after completion of the filters was carried on in substantially the same manner as



Top View of Intake Crib Ready to Tow; Center Cover Removed and Ports Temporarily Covered

with the coagulating basin alone, except that the use of the coagulating basin for reserve storage was abandoned to conform to the requirements of the State Board of Health and the reserve storage was limited to the 3,000,000 gal. capacity of the filtered water storage.

The cost of the filter plant addition amounted to a total of approximately $287,000, this being exclusive of the coagulation basin previously constructed.

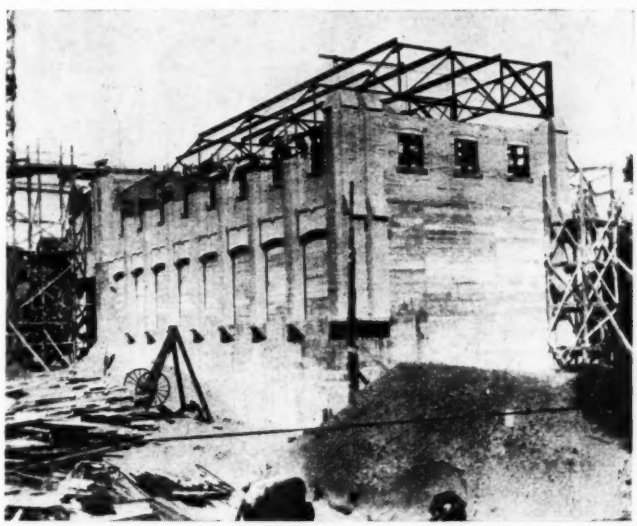
New Intake.—The contemplated 36-in. intake was finally undertaken in 1927.

It is interesting to note that the expedients outlined above had enabled the original 24-in. intake installed in 1886 to serve adequately for a population of 65,000. The time had come, however, when a new intake could no longer be deferred. The new intake was laid from the new water works lot to an intake crib located about 150 ft. from the old intake crib. The shore end was terminated at a 10 ft. diameter shore shaft 41 ft. deep, the intake pipe entering near the bottom. This shore shaft has been in use up to the present time as a suction well for a 10 m.g.d. d.c. motor driven centrifugal low lift pump located at lake level in an adjoining small pump house. This pump delivers water from the new intake directly to the filter plant, which, since completion of the new intake, has been supplied, except occasionally, by this unit.

The cost of the new intake was approximately $200,000. The low lift pump with pump house, pipe connections and power wiring, cost approximately $20,000.

New High Lift Pump.—Although the plant has always been able to meet the pumpage demands, it has, during recent years, been deficient in reserve capacity. This was partly overcome in 1927 by the addition of a 10 m.g.d. high lift unit in connection with the new intake construction. Advantage was taken of the opportunity to combine high lift pumping by steam at the old plant with electric pumping at the new isolated low lift pump house. This was accomplished by providing the new high lift unit with a generator on an extension of the pump shaft, the generator supplying current for the new low lift pump. This installation made a substantial reduction in the coal required for pumping, largely on account of the greatly improved efficiency of low lift pumping. The saving, however, was due in part to the reduction in low lift pumping head, brought about by taking the supply from the new intake instead of boosting from the old intake. The new high lift unit with accessory improvements cost approximately $36,000.

Standpipe.—To improve the distribution of pressures and to secure more efficient utilization of the distribution system and improve operating conditions at the pumping plant, the city in 1930 gave consideration to elevated storage. For this purpose, a standpipe of 2,750,000 gal. capacity is now being provided on high ground west of the city about opposite the pumping station and 3½ miles distant. The standpipe is 65 ft. in height. Approximately the upper 35 feet, providing 1,500,000 gal. storage, equivalent to 20 per cent of the average day pumpage rate, will be available for smoothing out the variations in pumpage rate otherwise necessary. This will leave about 1,250,000 gal. reserve storage below the normal minimum pressure level. This storage will be available either at reduced pressure in emergency or may be reclaimed by means of a 5,000,000 gal. motor driven booster pump provided in an adjoining pump house. This standpipe and booster pump installation will considerably improve the otherwise somewhat deficient capacity of the old pumping plant for emergency. The cost of this improvement, including connecting pipe line, is approximately $110,000.



Filter Plant Under Construction

New Pumping Station.—The final steps in carrying out the plant improvements outlined in 1920 are to be started this year with the construction of the new pumping station, suction well, tunnel intake connection and filter addition and water department service building, all located on the new water works lot. Studies were made comparing steam with electric operation, which resulted in the selection for this plant of electric pumping. The new plant will have high and low lift pumping capacity sufficient for the requirements of the city reasonably to be expected during the next 15 or 20 years with adequate reserve. The units are so spaced that they may be replaced as required by larger equipment so that the new pumping station building should serve adequately for at least 75 years without enlarge-

ment. The plant layout, including the filter plant, has been made with a view to ultimate enlargement to serve the indefinite future needs of the city up to any size that may reasonably be expected in this case. The improvements now being undertaken involve an estimated additional expenditure of approximately $640,000, providing that all of the work is undertaken now.

Summary.—Reviewing the program above outlined, a total expenditure of approximately $1,500,000, exclusive of main extension, will have been made over a period of about 12 years, averaging about $125,000 per year. The work has been done a step at a time. The money has always been spent so as to provide the most urgent improvement and so as to meet the requirements for plant capacity with the least possible expenditure.

By building conservatively and carrying the work out in steps over a period of years, it has been possible so far to finance the improvements entirely out of earnings. Spreading the work out has been of some advantage to the community in helping to maintain a normal level in construction activities. Building out of earnings of the water department has helped conserve the city's bonding power. It has been of benefit to the tax payers in avoiding interest payments on bond issues for water improvements. Furthermore, this policy of conservative progressive enlargement of plant facilities has kept down the total cost of the improvement by avoiding large expenditures at a time when prices were abnormally high and has enabled the city to contemplate completion of its program at a time when prices are abnormally low and work scarce.

It is evident that the policy of the Racine Water Board, as reflected in the program outlined above, has been greatly to the advantage of the community served.

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Meeting Southeastern Section of A. W. W. A.

The annual meeting of the Southeastern Section, American Water Works Association, was held in Columbia, S. C., April 7-8-9. One hundred sixty-five members and guests registered. The technical and business sessions were held in the Hotel Columbia. The program included the following addresses and papers.

Invocation—Rev. C. C. Herbert, Pastor Washington Street Methodist Church.

Address of Welcome—Dr. L. B. Owens, Mayor of Columbia.
Water Supply and the Public Health—Dr. J. A. Hayne.
Address—George H. Fenkell, President, A. W. W. A.
Association Affairs—B. C. Little, Secy. A. W. W. A.
Administration and Financial Problems at Macon, Ga.—R. E. Findlay.
Administration and Financial Problems at Thomasville, Ga.—D. Rhett Pringle.
Administration and Financial Problems at Griffin, Ga.—H. P. Powell.
Plankton and Public Water Supply—Hugh A. Wyckoff.
Use of Algaecides—J. H. Marquis.
Observations on Tastes and Odors—A. J. Smalshaf.
Ammonia-Chlorine Treatment of Water—Dr. J. F. T. Berliner.
Economics of the Selection and Operation of Centrifugal Pumps—Roland B. Hall.
Some Problems of Ground Water in the Southeastern States—David G. Thompson.
Water Softening—George Bacon.
Observations on Water Treatment at Atlanta—P. L. Weir.
Stream Pollution and Sewage Treatment Methods—J. M. Henderson.

A feature of the convention was a motorcade trip and inspection of Lake Murray earth dam and hydroelectric generating station. Following the inspection trip through the plant the Broad River Power Co. served a complimentary barbecue. This was followed by a motion picture illustrating the construction of the dam and power plant.

The City of Columbia was host at a banquet in the ballroom of the Jefferson Hotel. The banquet was the nucleus for an evening of merriment under the direction of Toastmaster Edward P. Hodges, Commissioner of Water Works in Columbia. The one minute talks of state, county and host city officials and association officers were followed by a rapid fire succession of stage numbers of a novelty program. A dance concluded the evening of good fellowship and fun.

The following officers were elected: Guy H. White, Chairman; H. P. Powell, Vice-Chairman; W. H. Weir, Secretary-Treasurer; H. F. Wiedeman, Director on Board of A. W. W. A.; H. W. Schumpert, Trustee; R. E. Findlay, Trustee; P. A. Tvargosky, Trustee; E. O. Sweet, Trustee.

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State and Municipal Borrowing in April Makes New High

The volume of State and municipal borrowing on bonds during the first four months of this year established a new high record with the flotation of new issues aggregating $556,272,810. Flotations in the corresponding four months' period never before reached the half a billion dollar mark, although in 1928 the total exceeded $498,000,000

The large total this year is accounted for by the issuance of $100,000,000 New York City bonds and a $35,000,000 New York State loan.

The following table prepared by *The Daily Bond Buyer* of New York compares municipal bond sale totals in April for the past ten years:

	April	4 mos. ending April 30
1931	$107,392,294	$556,272,810
1930	148,955,997	446,908,136
1929	87,343,450	358,503,108
1928	129,860,983	498,621,713
1927	124,807,889	464,233,101
1926	117,552,857	456,691,749
1925	106,981,731	417,176,986
1924	132,957,416	424,031,448
1923	89,030,844	342,666,184
1922	147,300,292	439,984,493

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Drought Caused Increased Salinity of Tidal Streams of Maryland

Periodic examinations, made in 1930 by the Bureau of Sanitary Engineering of Maryland State Department of Health, of the various rivers in the vicinity of Baltimore to determine unusual, but sporadic fish mortalities, showed that without exception increases in salinity of these fresh and semi-brackish waters had been great enough to disturb the environment of fresh water fish, resulting in a complete elimination of fresh water types and in an influx of salt water varieties into normally fresh water streams. This increase in salinity, obviously caused by the drought, was general in all tidal streams of the state. The extent of increases in salinity and sodium chloride content of the tidal streams is indicated by the findings of the Bureau of Sanitary Engineering and of the Department of Zoology and Agriculture of the University of Maryland. A normal specific gravity of 1.0017 for the Magothy River had increased to 1.0134 in November, 1930. The Severn River normal specific gravity of 1.0017 had increased to 1.0092 in November, 1930. At a point on the Susquehanna River where the normal specific gravity is 1.0000 it was found in November, 1930, to have increased to 1.00155.

The Pittsburgh Convention of the A. W. W. A.

Program of Papers and Committee Reports to Be Presented at the 51st Annual Meeting to Be Held May 25 to 29 at the William Penn Hotel, Pittsburgh, Penn.

The official opening of the 51st annual convention of the American Water Works Association, which is to be held May 25 to 29 at the Hotel William Penn, Pittsburgh, Pa., will be at 11 o'clock, Monday morning. In past years conventions were opened officially on Tuesday morning. The entire program, therefore, has been moved forward one day, with the exception of the meetings of the Finance and Accounting Division. This leaves Friday open for sessions of that division and trips to filter and manufacturing plants. Registration will start at 7 p. m., Sunday evening, May 24.

The exhibition of Water Works equipment and supplies promises to be unusually interesting this year. The exhibit committee has offered a suitable prize to be awarded to the manufacturer who has the most instructive exhibit at the convention this year. Many manufacturers are working to win this prize and are planning to show new features developed within the past year. A list of the exhibitors will be found elsewhere in this issue.

The program of the convention follows:

MONDAY FORENOON

8:00 Registration.
10:00 Parlor E. Water Works Practice Committee.
10:00 Cardinal Room. Presiding Officers of Sessions.

Main Session, Cardinal Room

11:00 Opening of Convention.
George H. Fenkel, President.
Address by the Honorable C. H. Kline, Mayor of Pittsburgh.
Announcement of Officers elected for the year 1931-32.
Reports of Secretary, Treasurer and Board of Directors.
Action on Budget. New Business.

MONDAY AFTERNOON

Main Session, Cardinal Room

Plant Management and Operation Division and Superintendents' Round Table Discussion.
Stephen H. Taylor (Chairman), Supt., Water Works, 312 Municipal Bldg., New Bedford, Mass.
2:00 Discussion will include the following topics:
1. Non-Shock Water Pressure Rating of Fittings (as related to proposed changes in standards). Discussion led by H. A. Hoffer, Eastern Sales Mgr., United States Pipe & Fdy. Co., 1421 Chestnut St., Philadelphia, Pa., and Charles Haydock, Cons. Engr., 2726 W. Somerset St., Philadelphia, Pa.
2. Lead vs. Compounds for Pipe Joints. Discussion led by E. G. Bradbury, County Sanitary Engr., Court House, Columbus, O.
3. Record Maps of Distribution Pipes and Valves. Discussion led by A. S. Hibbs, Supt., Dept. of Water Works, Cincinnati, O.
4. Rates for Outside Water Consumers.
5. Use of Cast Iron Pipe in Lengths Longer than 12 Feet.
6. Hydraulic Elevators.
7. Other topics as announced.

2:00 Blue Room. Committee on Standard Methods of Water Analysis. Everybody Welcome.
Jack J. Hinman, Jr. (Chairman), Assoc. Prof. of Sanitation, Univ. of Iowa, Iowa City, Ia.
5:00 Parlor C. Board of Directors.

MONDAY EVENING

6.30 Dinner. "Service des Eaux."
9:00 Informal Reception and Dance. Silver Room and Cardinal Room.

TUESDAY FORENOON

Main Session, Cardinal Room

George H. Fenkell (Chairman), Supt. and Gen. Mgr., Board of Water Commissioners, 735 Randolph St., Detroit, Mich.

9:30 Economy of Universal Metering.
E. A. Johnson, Pittsburgh Equitable Meter Co., 400 Lexington Ave., Homewood, Pittsburgh, Pa.
10:00 The Pittsburgh Water Works and Pressure Zoning.
James H. Kennon, Managing Engr., Bureau of Water, 416 City-County Bldg., Pittsburgh, Pa.
10:30 Effect of Acid Mine Drainage on River Water Supply.
Chester F. Drake, Div. Supt., Pittsburgh Filtration Plant, Aspinwall, Pa.
11:00 Tastes and Odors in Water, Causes and Remedies. Paul Hansen, Cons. Engr., 6 N. Michigan Ave., Chicago, Ill.
9:30 Blue Room. Committee on Boiler Feed Water Studies.
Sheppard T. Powell (Chairman), Chemical Engr., 213 St. Paul Place, Baltimore, Md.
12:15 Luncheon. Finance and Accounting Division.
12:30 Ladies Bridge Luncheon at Longue Vue Country Club.

TUESDAY AFTERNOON

Main Session, Cardinal Room

J. N. Chester (Chairman), Consulting Engineer, Clark Bldg., Pittsburgh, Pa.
2:00 Corrosion of Water Mains. (With particular reference to steel mains and including observations on European experiences.)
F. N. Speller, J. L. W. Birkinbine and H. R. Redington, all with National Tube Co., Frick Bldg., Pittsburgh, Pa.
2:30 Diversion of Water Works Funds.
Howell Wright, Attorney, and formerly Director of Utilities of City of Cleveland, O., 806 Fidelity Bldg., Cleveland, O.
Discussion led by James E. Gibson, Mgr. & Engr., Water Dept., 14 George St., Charleston, S. C.
3:10 Personnel Problems in American Water Works.
C. A. Dykstra, City Mgr., Cincinnati, O.
Discussion led by Wm. W. Brush, Chief Engr., Dept. of Water Supply, Gas & Elect., Municipal Bldg., New York, N. Y.
3:50 Gravel Wall or Gravel Packed Wells.
F. T. Quinn, Jr., Layne & Bowler, Inc., Memphis, Tenn.
Discussion led by Leon A. Smith, Supt., Water Works, City Hall, Madison, Wis.

Water Purification Division, Blue Room

John R. Baylis (Chairman), Physical Chemist, Bureau of Engineering, 1643 E. 86th St., Chicago, Ill.
2:00 Water Purification Problems in Mining and Manufacturing Districts.
Chester F. Drake, Div. Supt., Pittsburgh Filtration Plant, Aspinwall, Pa.
Discussion led by Edward C. Trax, Chemist, Filtration Plant, McKeesport, Pa., and H. E. Moses, Asst. Chief Engr., State Dept. of Health, 904 N. 2nd St., Harrisburg, Pa.
2:50 Manganese in Water; Its Occurrence and Removal.
Robert S. Weston, Cons. Sanitary Engr., 14 Beacon St., Boston, Mass.
(Ten minutes will be allowed for discussions.)
3:30 Symposium on Filtering Materials.
Filtering Materials for Water Works.
A brief general outline of the subject, the problems involved, and the need for cooperative effort in the study of filtering materials, will be given.
Wm. E. Stanley (Chairman, A. S. C. E. Committee on Filtering Materials for Water and Sewage Works), Pearse, Greeley & Hansen, 6 N. Michigan Ave., Chicago, Ill.
Experimental Work on Filter Sand.
It is planned to have several written discussions by those who have been cooperating with Mr. Armstrong on the study of filter sand. Following this the subject will be open for general discussion. Invitation is extended to every one having experience with filtering materials to discuss the subject. Written discussions are preferred.
James W. Armstrong, Filtration Engr., Montebello Filters, Hillen Road, Baltimore, Md.

TUESDAY EVENING

6:45 Dinner. Water Purification Division.

WEDNESDAY FORENOON

Main Session, Cardinal Room

Howard S. Morse (Chairman), Gen. Mgr., Indianapolis Water Co., 113 Monument Circle, Indianapolis, Ind.

9:30 Recent Developments in Elevated Tanks for Distribution Systems.
J. O. Jackson, Chief Engr., Pittsburgh-Des Moines Steel Co., Neville Island P. O., Pittsburgh, Pa.

10:00 Allocation of Streams.
Harold Conkling, Deputy State Engr., Division of Water Resources, State Dept. of Public Works, Sacramento, Calif.
Discussion led by Nathan B. Jacobs, Vice-Pres., Morris Knowles, Inc., 507 Westinghouse Bldg., Pittsburgh, Pa.

10:35 Aerial Maps for Water Studies.
Leon T. Eliel, Pacific Mgr., Fairchild Aerial Surveys, Inc., 224 E. 11th St., Los Angeles, Calif.
Discussion led by James W. Armstrong, Filtration Engr., Montebello Filters, Hillen Road, Baltimore, Md.

11:10 The Colorado River Aqueduct of Southern California Cities.
Julian Hinds, Designing Engr., Metropolitan Water District of Southern California, 222 S. Hill St., Los Angeles, Calif.
Discussion led by Thaddeus Merriman (Chairman, Engineering Board of Review of above District), Chief Engr., Board of Water Supply, 346 Broadway, New York, N. Y.

WEDNESDAY FORENOON

Water Purification Division, Blue Room

John R. Baylis (Chairman), Physical Chemist, Bureau of Engineering, 1643 E. 86th St., Chicago, Ill.
Session devoted to Taste Elimination Subjects. No discussions until all papers are read.

9:30 The Chemistry of Chloramines.
J. F. T. Berliner, Chemical Dept., DuPont Ammonia Corp., Wilmington, Del.

9:50 The Revivification of Granular Activated Carbon for Water Purification.
Paul Mahler, Chief Cons. Chemist, Darco Sales Corp., 45 E. 42nd St., New York, N. Y., and H. B. Crane, Principal Asst. Engr., International Filter Co., 59 E. Van Buren St., Chicago, Ill.

10:15 A Study of the Bactericidal Efficiency of the Ammonia-Chlorine Treatment.
H. H. Gerstein, Sanitary Engr., Dept. of Public Works, 8140 Drexel Ave., Chicago, Ill.

Water Purification Division, Blue Room

10:35 Combating Tastes in West Virginia Public Water Supplies in 1930.
E. S. Tisdale, Director, Division, of Sanitary Engineering, State Dept. of Health, Charleston, W. V.

10:50 Ammonia Salts in Taste Elimination.
Harry E. Jordan, Sanitary Engr., Indianapolis Water Co., 113 Monument Circle, Indianapolis, Ind.

11:00 Results of Taste and Odor Control with the Ammonia-Chlorine Treatment at Beaver Falls and New Brighton, Pa.
E. C. Goehring, Chemical Engr., New Brighton, Pa.

11:10 A Resumé of the Ammonia-Chlorine Treatment at Cleveland.
W. C. Lawrence, Supt. of Filtration & Sewage Disposal, Baldwin Filters, Fairmount Road, Cleveland, O.

11:20 Laboratory and Plant Results with Activated Carbon at Bay City's Filtration Plant.
Louis B. Harrison, Supt. of Filtration, Bay City, Mich.

11:30 Experience with Powdered Activated Carbon.
Malcolm Pirnie, Cons. Engr., 25 W. 43rd St., New York, N. Y.

11:40 General discussions from the floor.

For the Ladies

11:00 Sight-seeing Trip ending at the H. J. Heinz plant at 1:00 o'clock where luncheon will be served.

WEDNESDAY AFTERNOON

Main Session, Cardinal Room
Plant Management and Operation Division

Stephen H. Taylor (Chairman of Division), Supt. Water Works, 312 Municipal Bldg., New Bedford, Mass.
Presiding, G. Gale Dixon, Deputy Chief Engr., Mahoning Valley Sanitary District, 901 City Bank Bldg., Youngstown, O.

2:00 A Symposium—Operating Experiences with Gate Valves as Related to Needed Improvement in Design. Under auspices of Committee No. 7 (under the Water Works Practice Committee), which is drafting new specifications for gate valves.
Opening Statements:
(a) Seth M. Van Loan, Deputy Chief, Bureau of Water, City Hall Annex, Philadelphia, Pa.
(b) Loran D. Gayton, City Engineer, 402 City Hall, Chicago, Ill.

2:35 Discussions of above topic by:
Wm. W. Brush, Chief Engr., Dept. of Water Supply, Gas & Elect., New York, N. Y.
H. W. Griswold, Deputy Chief Engr., Board of Water Commissioners, Hartford, Conn.
G. L. Hendrickson, Asst. Managing Engr., Bureau of Water, Pittsburgh, Pa.
J. A. Jensen, Supervisor, Waterworks Dept., Minneapolis, Minn.
S. B. Morris, Chief Engr., Water Dept., Pasadena, Calif.
A. U. Sanderson, Mech. Engr., Dept. of Works, Toronto, Ont.
T. J. Skinner, Engr. of Distribution. St. Louis, Mo.
F. H. Stephenson, Engr. of Water System, Detroit, Mich.

3:25 Free discussion of above topic.

3:50 Service Pipe Materials and Practice in America. (Including summary of results of a questionnaire circulated by Sub-Committee 7-F, under the Water Works Practice Committee.)
James E. Gibson (Chairman Sub-Committee 7-F), Mgr. & Engr., Water Dept., 14 George St., Charleston, S. C.
Discussion led by Howard S. Morse, Genl. Mgr., Indianapolis Water Co., 113 Monument Circle, Indianapolis, Ind.

4:15 Free discussion of above topic.

Water Purification Division, Blue Room

Session devoted to discussion of topics for the revision of the Manual of Water Works Practice. This is part of the work of Committee 5, Quality and Treatment of Water, Paul Hansen (Chairman), Cons. Engr., 6 N. Michigan Ave., Chicago, Ill.

2:00 Standards of Quality and Objectionable Limits of Pollution.
Harry E. Jordan (Chairman), Sanitary Engr., Indianapolis Water Co., 113 Monument Circle, Indianapolis, Ind.
C. A. Emerson, Jr., Fuller & McClintock, Philadelphia, Pa.
H. W. Streeter, San. Engr., U. S. Public Health Service, Cincinnati, O.
M. N. Baker, Assoc. Editor, Engineering News-Record, New York, N. Y.

2:30 Biochemistry of Streams, Lakes and Reservoirs.
F. W. Mohlman (Chairman), Chief Chemist, Sanitary District of Chicago, 845 S. Wabash Ave., Chicago, Ill.
Emery J. Theriault, Chemist, U. S. Public Health Service, Cincinnati, O.
Gordon M. Fair, Assoc. Prof. of Sanitary Engineering, Harvard Univ., Cambridge, Mass.
W. F. Langelier, Assoc. Prof. of Sanitary Engineering, Univ. of California, Berkeley, Calif.
Frank E. Hale, Director of Laboratories, Mt. Prospect Laboratory, Brooklyn, N. Y.

3:00 Coagulation and Sedimentation.
John R. Baylis (Chairman), Physical Chemist, Bureau of Engineering, 1643 E. 86th St., Chicago, Ill.
Wellington Donaldson, Fuller & McClintock, New York, N. Y.
Frank W. Herring, Editorial Asst., Engineering News-Record, Chicago, Ill.
Willard C. Lawrence, Supt. of Filtration & Sewage Disposal, Baldwin Filters, Cleveland, O.

3:30 Lime and Soda Softening.
Charles P. Hoover (Chairman), Chemist, Filtration Plant, Columbus, O.
Daniel H. Rupp, Water Dept., Topeka, Kans.
Charles H. Spaulding, Supt., Water Purification, Springfield, Ill.
Sheppard T. Powell, Chemical Engr., Baltimore, Md.

WEDNESDAY EVENING

9:00 A. W. W. A. Night Club. Pirates Hall.

THURSDAY EVENING

Main Session, Cardinal Room

Stephen H. Taylor (Chairman), Supt., Water Works, 312 Municipal Bldg., New Bedford, Mass.
Plant Management and Operation Division and Superintendents' Round Table Discussion.

9:00 A Symposium—Pipe Corrosion and Corrective Measures. (A non-technical symposium with especial reference to control of corrosion by treatment of water.)
Opening Statement:

Malcolm Pirnie, Cons. Engr., 25 W. 43rd St., New York, N. Y.
Discussions, including outline of specific local experiences, by:
E. L. Bean, Chemist, Water Works, Providence, R. I.; Wm. W. Brush, Chief Engr., Dept. of Water Supply, Gas & Elect., New York, N. Y.; James M. Caird, Cons. Chemist, Troy, N. Y.; Keith R. Chinn, Chemist, West Palm Beach Water Co., West Palm Beach, Fla.; R. W. Fitzgerald, Chief Chemist, Division of Water Supply, Norfolk, Va.; Edward S. Hopkins, Principal Sanitary Chemist, Filtration Division, Baltimore, Md.; E. G. McConnell, Supt. of Plants, Water Dept., Charlotte, N. C.; Robert S. Weston, Cons. Sanitary Engr., Boston, Mass.
Discussion of Degree of Corrosion as Related to Pipe Friction.
Arthur T. Clark, Chief Engr., Community Water Service Co., New York, N. Y.

10:10 Symposium opened to free discussion.

10:35 Superintendents' Round Table Discussion.
Sub-Aqueous Pipe Lines.
Discussion led by A. T. Ricketts, Deputy Chief Engr., Public Works Engineering Corp., New York, N. Y.; H. L. Clark, Engr., U. S. Engineering Corp., New York, N. Y., and James W. Graham, Treas. & Genl. Mgr., Portland Water District, Portland, Me.
Making Water Works Structures Attractive.
Discussion led by George T. Horton, Chicago Bridge & Iron Works, Chicago, Ill., and James W. Graham, Treas. & Genl. Mgr., Portland Water District, Portland, Me.
Other topics as introduced from the floor.

12:00 Business Meeting, Plant Management and Operation Division.

Finance and Accounting Division, Blue Room

Hal F. Smith (Chairman of Division), Head Clerk, Water Consumers Accounts, Dept. of Water Supply, Detroit, Mich.
Presiding, L. M. Anderson, Controller, Dept. of Water & Power, 207 S. Broadway, Los Angeles, Calif.

9:00 Round Table Discussion.
Theme—Office Management, Accounting and Records.
Installing an Accounting System in a Small Plant. Discussion led by Ralph A. Hoot, Water Works Engr., 361 Merton Road, Detroit, Mich.
What are the Advantages of "Stub Accounting"? Discussion led by Lawrence M. Bailey, City Controller & Supt. Water Dept., Lincoln Park, Mich.
What Progress is Being Made with the Application of Tabulating Machines to Customer Accounting? Discussion led by R. M. Sedgewick, Accountant, East Bay Municipal Utilities District, Oakland, Calif.
How Many Accounts are Necessary for the Practical Application of Mechanical Billing Equipment? Discussion led by W. P. Adams, Public Utility Division, Burroughs Adding Machine Co., Detroit, Mich.
The Permanent Meter Reading Book versus Temporary Meter Reading Slips. Discussion led by Carl K. Chapin, Commercial Director, Dept. of Water & Power, 209 S. Broadway, Los Angeles, Calif.

Finance and Accounting Division, Blue Room

A Problem in Depreciation. Discussion led by Joseph Gill, Accountant, 74 Trinity Place, New York, N. Y.
Printed Forms and Their Control. Discussion led by H. J. Johnson, Public Utility Service Dept., Remington-Rand Business Service, Inc., Buffalo, N. Y.
The Theme, Discussed from the Canadian Point of View. A. B. Manson, Genl. Mgr., Public Utility Commission, Stratford, Ont., and R. M. Bond, Auditor of Municipal Accounts, Hydro-Electric Power Commission of Ontario, Toronto, Ont.
Needed Legislation to Secure Funds for Water Works Extensions and Additions. Discussion led by E. W. Agar, formerly Supt., Water Dept., Valparaiso, Ind.

THURSDAY AFTERNOON

Main Session, Cardinal Room

W. W. DeBerard (Chairman), "Engineering News-Record," 520 No. Michigan Ave., Chicago, Ill.

2:00 A Symposium. The 1930 Drought and Its Lessons.
Opening Statements:
(a) F. R. Berry, Engr., American Water Works & Electric Co., 50 Broad St., New York, N. Y.
(b) Reeves J. Newsom, Vice-Pres., Community Water Service Co., 46 Cedar St., New York, N. Y.
Following the opening statements the drought problems will be discussed under four main aspects as follows:

2:30 Need for Reappraising Customary Design Assumptions. (As related to Yield of Supply Source and Peak Load Capacities that should be provided in Supply Source, Purification Works, Pumping Works, Distribution System and Connecting Parts.)
Discussion led by Paul Hensen, Cons. Engr., Chicago, Ill.; John F. Laboon, Cons. Engr., Pittsburgh, Pa.; N. T. Veatch, Jr., Cons. Engr., Kansas City, Mo.; Ezra B. Whitman, Cons. Engr., Baltimore, Md.

2:55 Free discussion of above sub-topic.

3:10 Need for Better Records of Rainfall and Stream Flow as a Basis for Forecasting Watershed Yields.
Discussion led by John C. Hoyt, Hyd. Engr., U. S. Geological Survey, Washington, D. C.

3:20 Free discussion of above sub-topic.

3:30 Effect of Drought on Water Quality.
Discussion led by J. W. Armstrong, Filtration Engr., Montebello Filters, Baltimore, Md.; F. C. Dugan, Director, Bureau of Sanitary Engineering, State Board of Health, Louisville, Ky.; H. F. Ferguson, Chief Engr., State Dept. of Health, Springfield, Ill.; Martin E. Flentje, Community Water Service Co., Harrisburg, Pa.; Thomas R. Lathrop, Asst. Sanitary Engr., State Dept. of Health, Columbus, O.; George D. Norcom, Federal Water Service Corp., New York, N. Y.; C. E. Trowbridge, American Water Works & Electric Co., New York, N. Y.

4:10 Free discussion of above sub-topic.

4:25 Emergency Water Relief Measures During Drought.
Discussion led by F. C. Dugan, Director, Bureau of Sanitary Engineering, State Board of Health, Louisville, Ky.; H. F. Ferguson, Chief Engr., State Dept. of Health, Springfield, Ill.; Thomas R. Lathrop, Asst. Sanitary Engr., State Dept. of Health, Columbus, O.; H. E. Moses, Asst. Chief Engr., State Dept. of Health, Harrisburg, Pa.

4:50 Free discussion of above sub-topic.

Finance and Accounting Division, Blue Room

Hal F. Smith (Chairman), Head Clerk, Water Consumers Accounts, Dept. of Water Supply, Detroit, Mich.

2:00 The Silent Partner.
In which the old subject of Public Relations is discussed in a new way.
A. P. Michaels, Genl. Mgr., Orlando Utilities Commission, Orlando, Fla.
A Rating Scale for Public Relations.
The entire subject is broken up into its component parts, each part considered as to its relation to the whole, correspondingly weighted, and reassembled resulting in a yardstick applicable to any water works.
Howard S. Morse, Genl. Mgr., Indianapolis Water Co., 113 Monument Circle, Indianapolis, Ind.
Discussion led by A. P. Michaels, Genl. Mgr., Orlando Utilities Commission, Orlando, Fla.
Personnel: Service Rating Methods and Records.
Pointing out the reason for the growing demand for some satisfactory method of measuring employees' service value, including a brief description of the Probst System and its application.
Joseph F. Majeske, Director of Personnel, Dept. of Water Supply, Detroit, Mich.
Discussion led by C. A. Dykstra, City Mgr., Cincinnati, O.
Purchasing by Competitive Bidding.
Covering such points as securing of bids by request for quotation forms; covering the business by a contract; Purchasing Department index by materials, showing suppliers' names and quotations.
Charles J. Alfke, Comptroller, Hackensack Water Co., 624 Park Ave., Weehawken, N. J.

For the Ladies

1:00 Style Show and Luncheon at Kaufman's.

THURSDAY EVENING

7:00 Dinner Dance—Informal. Dinner in Pirates Hall. Dancing in Cardinal Room.

FRIDAY FORENOON

Finance and Accounting Division, Blue Room

Presiding, D. C. Grobbel, Secretary, Dept. of Water Supply, Detroit, Mich.

9:00 Theme—Valuation, Rate Making and Taxation.
State Franchise Taxes. Charles J. Tobin, Attorney, Albany, N. Y.
Trend of Rate Structure in Michigan Cities. Showing a distinct tendency towards the adoption of the A. W. W. A. Standard. G. D. Kennedy, Civil Engr., Dept. of Water Supply, Pontiac, Mich.

Perpetual Plant Inventory. E. E. Bankson, Cons. Engr., 6562 Bartlett St., Pittsburgh, Pa. and Nathan B. Jacobs, Vice Pres., Morris Knowles, Inc., 507 Westinghouse Bldg., Pittsburgh, Pa.
Depreciation Allowance for Federal Income Taxes. Louis D. Blum, Certified Public Accountant, 110 E. 42nd Street, New York, N. Y.
Water Service and Local Taxes. J. Mark Wilcox, City Attorney, West Palm Beach, Fla.
Marketing Public Utility Securities. H. Gordon Calder, International Public Service Corp., 27 William St., New York, N. Y.

9:30 Parlor C. Board of Directors.

FRIDAY AFTERNOON

Finance and Accounting Division, Blue Room

Hal F. Smith (Chairman), Head Clerk, Water Consumers Accounts, Dept. of Water Supply, Detroit, Mich.

2:00 Committee Report: Standard Classification of Accounts. F. H. Gorman (Chairman), Comptroller, National Water Corp., 11 Broadway, New York, N. Y.
Regular Business Meeting of the Division.

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Exhibitors at Pittsburgh Convention A. W. W. A.

Everything indicates that the exhibits of water works equipment and materials at the 51st annual convention of the American Water Works Association, May 25 to 29, at Pittsburgh, Pa., will be unusually educational. Many exhibitors applied for large spaces and in order for all applicants to be able to exhibit, the majority of the spaces had to be reduced in size. The following is a list of the exhibitors:

Edson Mfg. Corp.
Eddy Valve Co.
James B. Clow & Sons
Layne & Bowler, Inc.
McWane Cast Iron Pipe Co.
The American Brass Co.
National Tube Co.
Badger Meter Mfg. Co.
The Paradon Co.
American Cast Iron Pipe Co.
Pittsburgh-Des Moines Steel Co.
U. S. Pipe and Foundry Co.
Michigan Valve & Foundry Co.
Engineering News-Record
Fairbanks, Morse & Co.
Water Works & Sewerage
National Meter Co.
The American Rolling Mill Co.
Columbian Iron Works
W. & L. E. Gurley
Chicago Bridge & Iron Works
The Leadite Co.
The American City Magazine
Builders Iron Foundry
Lock Joint Pipe Co.
The Dorr Co.
Darling Valve & Mfg. Co.
Iowa Valve Co.
The Atlas Mineral Products Co.
Phoenix Meter Corp.
Canadian Engineer
Water Works Engineering
Worthington Pump & Machinery Corp.
The Kennedy Valve Mfg. Co.
Vogt Brothers Mfg. Co.
Simplex Valve & Meter Co.
Bingham & Taylor Corp.
H. W. Clark Co.
Joseph G. Pollard Co., Inc.
National Cast Iron Pipe Co.
A. M. Byers Co.
S. R. Dresser Mfg. Co.
Neptune Meter Co.
Ludlow Valve Mfg. Co.
R. D. Wood & Co.
East Jersey Pipe Co.
Mueller Co., Inc.
Pittsburgh Equitable Meter Co.
Wallace and Tiernan Co., Inc.
Public Works
Hersey Mfg. Co.
The A. P. Smith Mfg. Co.
Hydraulic Development Corp.
Wailes Dove-Hermiston Corp.
National Water Main Cleaning Co.
Hays Mfg. Co.
Mueller Brass Co.
Victaulic Co. of America
De Laval Steam Turbine Co.
Rensselaer Valve Co.
Ross Valve Mfg. Co., Inc.
Gamon Meter Co.
Jenkins Bros.
Omega Machine Co.
Inertol Company, Inc.
International Filter Co.
Pardee Engineering Co.
Buffalo Meter Co.
The Pitometer Co.
Union Water Meter Co.
Birch Mfg. Co.
R. W. Sparling
Automatic Cone Valve Co.
Lead Lined Iron Pipe Co.
Ford Meter Box Co.

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Cost of Laying 48-In. Main at New Bedford, Mass.

During 1930 the Water Department of New Bedford, Mass., of which Stephen H. Taylor is superintendent, laid 6,689 ft. of 48-in. cast iron force main, the working being done by department labor. The line was laid through a swamp, making construction conditions difficult. The following details of the work are taken from the 1930 report of the department.

In order to obtain a satisfactory foundation, it was necessary to drive piles, capped with 10x12-in. yellow pine timbers. As the department is not equipped for pile driving, a contract was entered into, after duly advertising for bids, with Frank C. Taylor, the low bidder. The rest of the work was done by department forces. In some parts of the swamp it was necessary to drive piles to a depth of over 50 ft. to obtain a good bearing. This necessarily slowed up the work.

The cost of the work was as follows:

	Total	Per Ft.
Pipe and Specials and Inspection	$101,070.79	$15.11
Leadite and Gasket	1,605.36	.24
Tools and Repairs	5,005.18	.76
Labor	27,256.82	4.08
Fuel, Oil and Grease	1,740.54	.25
Piling and Capping	30,505.16	4.56
Lumber	1,687.67	.25
Advertising, Supplies and Misc.	433.12	.06
Accident Account	10.00	
Totals	$169,314.64	$25.31

The labor costs were as follows:

	Total	Per Ft.
Unload and Distribute 48-In. Pipe	$ 1,935.22	$0.29
*Excavation	6,062.20	.91
Laying 48-In. Pipe	2,519.22	.38
**Backfill	7,636.72	1.14
Railroad and Locomotive Crew	2,076.18	.31
Pumping	225.37	.03
Clearing	2,280.28	.35
Watchman	593.90	.09
Culverts	655.84	.10
Tools and Repairs	2,469.17	.37
N. Y., N. H. & H. R. R. Crossing	94.96	.01
Accident Account	74.57	.01
Miscellaneous	633.19	.09
Totals	$27,256.82	$4.08

*Includes considerable excavation ahead of pipe actually laid.
**Incomplete—Estimate to complete $5,000.

The pipe cost $40.90 net per ton plus $1 per foot for bitumastic enamel lining. Special cost $1.35 per ton plus $8 per ton for bitumastic lining.

. . . EDITORIALS . . .

We Move

We wish to extend to all of our readers a cordial invitation to visit us in our new quarters. The office of the Gillette Publishing Company, publishers of this magazine, has been moved to Room 865 in the Chicago Daily News Building. The building is within five minutes walking distance of the center of the Loop and lies on the west bank of the Chicago River opposite the New Civic Opera Building which lies on the east bank.

Our office building is connected to the Chicago and Northwestern Railroad terminal by a concourse and is just two blocks from the Chicago Union Depot. We hope you will call on us on your visits to Chicago.

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Clay Varves as Rain-Gages

During the past four years the editor has been studying tree-rings and clay-varves, using them as ancient rain-gages or precipitation records. Prof. Douglass was the first to apply scientific methods to tree-ring studies, with a view to discovering precipitation cycles. The editor was perhaps the first to investigate clay varves in a similar manner.

Clay varve measurements were first made by Prof. Gerard de Geer of Sweden, who has counted and measured a series of about 18,000 varves, representing as many years. Elsewhere in this issue Ransome Sutton's article on this subject explains the nature of clay varves. In that article he says that these annual layers of clay that were deposited in ancient glacial lakes vary in thickness "because thick varves mean warm weather and thin varves colder weather." That is De Geer's theory of their varying thickness. The editor has reached a different conclusion, and regards annual varve thickness in a given locality as being mainly dependent upon the precipation each year in that locality. This inference is based on the fact that cyclograms of annual precipitation, annual tree-rings and annual varves, all agree in disclosing similar cycles. Thus, the 11.203-year cycle is prominent in all these records when a long period of time is covered. A 7-year cycle is also very marked. There are, in fact, nearly two score of such cycles. Mean annual temperature records fail to show sufficient cycle changes to account for the cycles in varve thickness on the theory of ice melting, whereas precipitation records disclose rhythms that are found in clay varves.

This generalization is very important, for it serves to direct attention to clay varves as rain-gages rather than as thermographs. We are in sore need of annual precipitation records that cover many more centuries than the 32 centuries covered by the sequoias or giant redwoods of California.

Next in importance to having such long records as the varves furnish is the dating of those varves. In *Engineering and Contracting*, October, 1928, the editor made his first attempt to determine the date of De Geer's zero year. De Geer had said that he believed his zero varve was deposited about 6800 B. C., because the evidence was clear that the most recent Swedish varve is not more than two centuries old, and probably not more than a century old. In the article above mentioned the editor assigned a date of 6846 B. C. to De Geer's zero varve, basing his determination upon the Uranus weather cycle of 81.15 yrs. and the Neptune weather cycle of 161.57 yrs. Subsequent studies have disclosed that these cycles are 82.212 and 161.614 yrs., respectively. But of much greater importance than these changes in the lengths assigned to these cycles has been the use of cyclograms instead of ocular inspection of curves of varve thickness. By aid of the Balfour Stewart cyclogram method of analysis (a method outlined by Clayton in "World Weather," p. 376) the editor has been able to ascertain the lengths of many new weather cycles and of several old weather cycles, with great precision. Equipped with such accurate knowledge, it is easy to close any chronological gaps either in clay-varve or in tree-ring records, provided only that the records cover about 20 long cycles, and provided that two or more cycles are used in such a "triangulation" survey of the records.

The result of the editor's latest survey of the varve and tree-ring data is this: De Geer's zero year in his varve series is 6840 B. C. Hence De Geer was right when he said that he believed that his 6800 B. C. date of that varve did not err by more than a century.

De Geer has to his credit the remarkable achievement of correlating clay varves on four continents, Europe, North America, South America and Asia. For example, he has shown that varve No. 3001 in Antevs' Connecticut Valley series is of the same date as De Geer's varve —5684, or 5684 yrs. prior to De Geer's zero varve. The editor's cyclogram analysis confirms De Geer, and, in addition, gives to Antevs' varve No. 3001 the date 12,524 B. C. Antevs' varve measurements in the Connecticut Valley and vicinity cover an unbroken series of 3,652 varves, corresponding to as many years. He has measured several other series in New England and Canada between which gaps exist. The editor has closed several of these gaps, and expects soon to make available the dates of about 9,000 of Antevs' varves for use in determining precipitation cycles and their relative importance. Antevs, following De Geer's lead, has regarded varves as being thermographs. This led him to make the natural mistake of regarding an occasional very thick varve as being the result of the bursting of an ice dam, for he was unable to explain it by the theory of sudden, great changes of terrestrial temperature. But, on the theory that very thick varves are the result of exceptionally heavy snow and rain, these giant varves take on importance, for they can be used to determine the peak dates of precipitation cycles. The editor finds that where the smoothed curve of a cyclogram discloses a peak then in or near that peak year, one or more giant varves are often found. Probability calculations show that this is not an accidental correlation, so it is now certain that the giant varves record great precipitation, and not the bursting of ice dams.

Meteorologists have often regretted the fact that rain-gages have been in use by man not longer than about two and a half centuries. In England annual rainfall records date from 1677, in New England from 1750, in California from 1849. The head of our Weather Bureau recently said that it might be necessary to wait several centuries before man's precipitation records

would be long enough to solve the problem of weather cycles. Now it is clear that the clay varves furnish means of testing any weather cycle at least as far back as 16,500 B. C.

Bradley's recent discovery of a cycle of about 21,500 yrs. in the varved shales of Colorado opens up an almost unlimited field for the investigation of long cycles, by the side of which man's two and a half century rain-gage records are the doings of yesterday.

▼

The Basic Method of Scientific Research

Mathematics and astronomy are the only sciences older than logic. In spite of its age, logicians differ even as to the nature of the two basic forms of reasoning, namely induction and deduction. Three of the most eminent British writers on logic were Mill, Whewell and Jevons. They were never able to come to an agreement as to the fundamental nature of induction and deduction. While all agreed that the inductive process leads to generalizations, they could not agree as to the mental processes involved.

It has long seemed to the editor that their failure to come to an agreement originated in their failure to see that a new generalization is fully established only by the sense-organs. While it is true that they all said that the truth of a theory can be established only by showing that it accords with facts, they failed to place sufficient emphasis upon the process by which such an accord is found to exist. That process is always one of observation, and observation is but a term that denotes the use of the sense-organs. These three great logicians were so concerned with what may be called the "mental processes" of reasoning that they gave insufficient consideration to the "sensual processes" upon which reasoning is based and by which reasoning is confirmed.

If we regard all reasoning as being expectant memory we shall see that the confirmation of the expectation by observation is the proof—and the only proof—of the soundness of the reasoning. This weds the mental process to the physical or sensual process. An example will illustrate what we mean.

If a flame is seen, for the first time, and the hand attempts to seize it, a burn, with its attendant pain, occurs. At a later time another flame is seen and it is instantly inferred that it will cause pain if touched. Mill, Whewell and Jevons tell us that this is merely reasoning by analogy, and that not until many flames have been investigated without finding a single exception, is the induction framed that: "All flames cause pain when touched by the skin." Then they add that when such an induced generalization has been established by experience and not till then does true deduction occur, expressible in the syllogistic form thus:

1. All flames if touched cause pain.
2. This thing is a flame.
3. Therefore this thing will cause pain if touched.

Here we have (1) the "major premise," (2) the "minor premise" and (3) the deduced conclusion or inference. But even a dog draws precisely the same inference after a single painful contact with a flame. Where, then, shall we draw the line between one experience and many in laying the basis for an inference of this sort? The answer seems to be that only a sufficient number of experiences are required to form a sense-record that persists until the occurrence of another similar event. There is, therefore, no way of distinguishing between the three primitive processes that we label (1) analogical reasoning, (2) inductive reasoning and (3) deductive reasoning. They all reduce to one the same thing—expectant memory.

At first it seems incongruous that the discovery of a scientific law can be the result of expectant memory; for how can a man discover only what he remembers? The answer is that Nature endlessly repeats certain phenomena and also repeats the same fundamental "patterns" in phenomena that often seem entirely different. The dog's inherited sense-records suffice to assure him that similar things usually cause similar effects; so a single burn is basis enough for correct inferences thereafter respecting flames. In the case of a research scientist, a reading of the experiences, furnishes the basis for a generalization such as this: No two phenomena are utterly unlike; and guided by a visible likeness, however faint, likenesses as yet unseen are discoverable.

In brief, the slightest analogy furnishes the clue upon which a tentative theory may be framed. A generalization is based on this theory and deductions are drawn from the generalization, whereupon observations are either made or old ones investigated to the correctness of the inference. If this is a true description of the basic process of scientific research, it follows that research is an expectant memory process in which both mind and body cooperate. It starts with an observed likeness, and this involves both memory and the organs of sense. It moves along to the inference that other likenesses exist. It usually seeks to discover at least one other likeness so as to narrow the field to be explored by the organs of sense. It infers from the one or more observed likenesses, that the phenomenon under investigation possesses some other attribute usually found associated therewith. And it searches for confirmation of the correctness of that inference.

Scientific research that leads to true inductions of a general nature involves exploration of nature by the sense organs, which exploration is usually the most fruitful when guided by a tentative theory based on some analogy between the phenomenon under investigation and some better known phenomenon.

So far as the brain part of the process of inductive reasoning is concerned it apparently does not differ at all from deductive reasoning. An artificial distinction however, may be drawn, but the distinction is solely one of degree of probability of the truth of the generalization. The major and minor premises of syllogistic deduction are assumed to be so highly probable as to amount to practical certainty. In that case the truth of the inference is also practically certain. But in the case of an inductive inference, before its truth has been established by the sense organs, there is only some degree (often very small) of probability that its major premise is true. The major premise, which is derived from some analogy, is provisionally assumed to be true, so that an inference may be drawn from it. Then comes the sense-organ process of investigation upon which to base a calculation as to whether the inference is probably correct. We say "then comes," when we should say "then should come." Unfortunately many would-be researchers stop short of testing the truth of their inferences by an appeal to enough facts to permit an application of the principles of mathematical probability.

H. P. Gillette

Recent Developments in the Water Works Field

New "Chicago" Pumps Announced

Two new pumps have been developed by the Chicago Pump Company, Chicago, Ill., one of which is a close coupled medium capacity pump, the other, a non-clog sewage and drainage pump.

The N-Type close-coupled pumps will carry 200 lb. pressure on suction. Therefore, they must be of heavy, substantial construction.

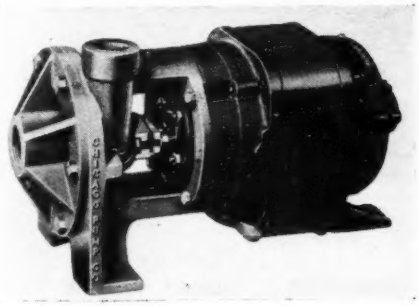
They are compact, close-coupled, use minimum space, and operate quietly.

N-Type pumps are mounted on three feet, so that they will rest evenly on any surface. There is no strain applied to unit when bolting down. Three point mounting cannot get out of alignment under ordinary operating conditions.

Two of the three feet are placed under the pump to support weight of pipe, thereby relieving the motor shaft and motor frame of any excessive stress or strain.

The non-clogging impeller used in the sewage and drainage "Chicago" pumps is distinctive in design.

A heavy, 4-legged, tongued-and-grooved semi-steel pedestal supports the motor. Because of the tongued-and-grooved construction perfect alignment is provided



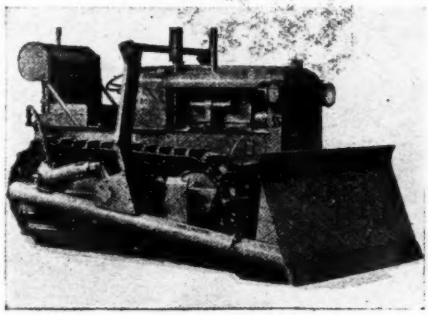
N-Type Close-Coupled "Chicago" Pump

between motor and pump. Alignment is accomplished automatically, at the factory, thereby eliminating this necessity and expense on the job.

A particularly worth while advantage in "Chicago" enclosed shaft pumps is the tongued-and-grooved construction. Quick and easy installation, permanent alignment on job and long life of pump are attributable to this outstanding improvement.

Baker Built Bulldozer

Here is a hydraulic bulldozer built upon a new idea. The lifting and lowering of the moldboard is done through twin cylinders, one on each side of the tractor and directly connected to the lifting cranks mounted on Timken roller bearings. The moldboard can be moved up and down through a range of 26 inches. It can be adjusted to cut from 6 to 10 inches below the level of the ground. The push beams of the Bulldozer are hinged at the ends of the rear axle of the tractor, the logical point for applying the load. The weight of the Bulldozer is carried directly on the center line of the tractor tracks. Due to the fact that the lifting cylinders are directly connected, the weight is evenly distributed on both tracks at all times. The moldboard is of heavy construction



Monarch 52 Bulldozer

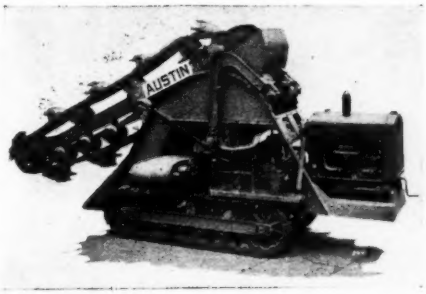
with deck-plates forming a girder parallel with the ground. It is 40 inches high and 88 inches wide. Both cutting edge and moldboard are easily removed for replacement. The tractor draw bar is left entirely free for use in attaching or pulling other implements or machines. Easily operated levers in the cab of the tractor permit instant positive control for raising or lowering the blade. The Baker Manufacturing Co., Springfield, Ill., will furnish additional information on request for unit made to attach to either a Monarch or Caterpillar tractor.

Austin Improves Equipment

The Austin Model 55 fully convertible power shovel was designed and built for the purpose of producing a better value—still faster, still more dependable. Simplicity of design results in economy of operation. Unit construction throughout, fewer working parts and two-speed transmission are provided for all operations. Oversize parts, skilled workmanship, easy accessibility for adjustments and replacement parts, all result in greater efficiency, lower maintenance, and machine built to endure.

The capacity is 11 cu. ft. struck measure, ½-yd. working capacity and lifting capacity 12,000 lb.

The Austin Model 90 Public Service ditcher embodies those same in-built principles of design, quality and performance, that have made Austin products universally famous.



New Austin Model 90 Ditcher

The Model 90 has a bucket capacity of 12 in. to 30 in., digging depth of 0 ft. to 8 ft., overall width outside to outside 5 ft. 3 in., two-speed bucket line and sixteen speeds for digging. Positive boom crowd by use of self-locking worm gear and 20 in. standard conveyor.

The Model 90 with its many mechanical refinements is a machine that will perform profitably for years to come in the toughest service. Further details may be obtained from the Austin Machinery Corporation, Muskegon, Mich.

Two New CP Tools

Chicago Pneumatic Tool Co. of New York City announce two new developments for this year. The first is a sheeting driver and the second a portable sump pump.

The CP-116 sheeting driver is essentially the CP-116 demolition tool with a special front end, designed primarily to take wooden sheeting, although light steel sheet piling can also be successfully driven. It can be used to advantage in

New Chicago Pneumatic Portable Sump Pump

trench work and excavations, in formations that sheeting will penetrate without breaking, such as clay, sand, gravel, etc.

Tests show it to have unusual capacity, due to the fast, powerful blow and, depending on conditions, it will do the work of 8 to 10 men with mauls. Sheeting can be used over and over, since there is no tendency to "broom" as when driven by hand, thus effecting a substantial saving in material.

Like the CP-116 demolition tool, the sheeting driver is low in air consumption and has no tendency to "freeze" in the coldest weather. It is of the valveless type—only one moving part, the piston—symmetrical and well-balanced and light enough, 105 lb., for ready portability and use as a "one-man" tool.

The CP portable pneumatic sump pump is a simple, low-priced force pump that can be operated from any portable air compressor of 100 cu. ft. capacity or

greater. It removes water from manholes, ditches or pits quickly and cheaply.

Slim, trim, well-balanced, and weighing only 50 lb., the CP pump can be handled or carried as readily and easily as any pavement-breaker, clay digger or other similar pneumatic tool.

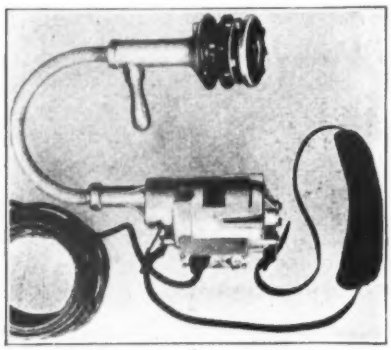
Attach a 2½-in. water hose and a ¾-in. air hose and the pump is hooked up ready for action.

Berg Surfacer Improved

An improved model "A" Berg concrete surfacer and finisher is announced by the Concrete Surfacing Machinery Company of Cincinnati, O. It is of simple, foolproof construction. All parts, guaranteed free from defects, are made of finest materials and are carefully assembled to withstand a cutting strain of 2700-3500 r.p.m.

The Berg is unequalled for removing fins, board or form marks and all surface irregularities from concrete construction. The distinctive results obtained are beyond comparison.

In addition, the Berg is ideal for producing special finishes. It cuts brick walls



Berg Concrete Surfacer and Finisher

preparatory to stucco application and grinds paint from bricks. The Carbo Disc, interchangeable with the cutter head, is used for grinding, smoothing and grouting surfaces.

Edson Type "RM1-UT" Power Force Pump

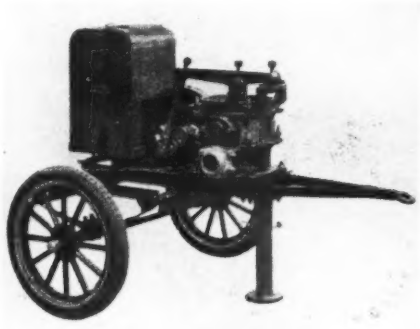
All the successful features of the Edson diaphragm pump are embodied in their latest type "M" force pump.

This new pump is built with a cylinder head and ring to hold a standard diaphragm. This seals the upper or pressure chamber so the liquid is forced through the discharge outlet in a clean and odorless manner. May be used with or without discharge hose.

Used for sewage, cesspools, vats, pits, trench, manhole, or similar work on liquid or semi-liquid matter.

The model "U" roller type engine has hood over engine, all bearings running in oil, all gears inclosed and running in oil. This prevents injury to operator or damage to machine. The new oil enclosed Edson reduction jack is also standard equipment on these pump units.

Mounted on a strongly built welded steel frame, with standard Ford wheels with demountable rims and puncture proof tires. The standard which holds the pump upright is rigid when in use and can be quickly attached or detached. This unit will trail without trouble. It is efficient,



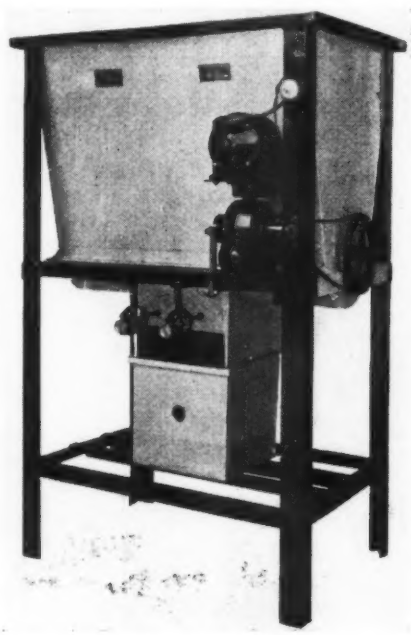
Edson Latest Type Force Pump

compact, and built for heavy duty. Further information may be obtained from the Edson Manufacturing Corporation, 49 D St., South Boston, Mass.

Bacharach Develops Feeder

A novel type of dry chemical feeder developed by E. W. Bacharach & Co., Kansas City, Mo., is shown in the accompanying illustration. This particular machine will accurately feed any two different chemicals simultaneously in different amounts. It may also be used to feed two different amounts of the chemical to separate points of application. The same principle of construction is carried out in building a machine for feeding three or more chemicals.

Some of the advantages of installing a single unit machine that will do the work of a number of individual devices are reduced initial cost of apparatus, decreased installation expense, saving of space and



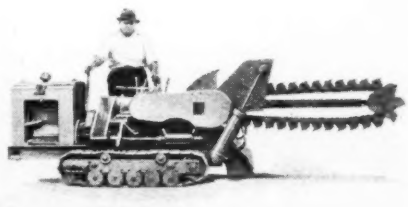
Bacharach Multiple Type Dry Chemical Feed Machine

power, and less repairs and depreciation. The multiple feed machine is built for any capacity to meet the requirements of any particular installation. E. W. Bacharach and Company also builds single feed machines and a complete line of other types of dry chemical feeders designed to meet unusual conditions as well automatically proportionate devices.

C. H. & E. "Goldigger" Model "A" Ditcher Developed

The great amount of hand work required in digging ditches for laying small pipe brought about the development of the Little Goldigger by the C. H. & E. Division of National Equipment Corporation, Milwaukee. This labor-saving ditcher, only waist high, not only digs a trench many times faster than hand work, but removes a comparatively small amount of dirt because of the narrow trench. Backfilling is reduced to a minimum.

Designed and developed to dig a trench from 3 in. to 6 in. wide, the C. H. & E. Goldigger has a wide utility range for digging gas service connections, high



Little Goldigger Announced by C. H. & E.

pressure gas lines, small oil pipe lines, ornamental lighting cables, telephone cables, sprinkling and drain pipes in golf grounds and airports, and in any other underground work that requires a trench up to 6 in. in width and 48 in. in depth.

Digging speeds vary from 1 to 6 ft. per min. Two speeds are available without changing sprockets and 36 speeds may be had by changing sprockets. Full multiplane traction with very low ground pressure permits operation on wet soil without miring and on lawns and parkways without injury to the grass.

Operating levers have been centralized on one side of the Goldigger for convenience of the operator in keeping his machine digging to the best advantage at all times. It can be used in very small spaces and its narrow width will allow it to pass buildings, trees, electric light and telephone poles, where the clearances are small.

Rugged construction has been well balanced throughout the machine. All parts are built for severe and continuous service. Gears and sprockets are of steel properly heat-treated. Gears are enclosed in gear cases and run in oil. The oil in the main gear case is used for the hydraulic boom lift and is circulated back over the top of the gears in the case, giv-

ing them a continuous oil bath. A four-cylinder, 12-hp. engine provides plenty of power for all operations.

An eight-page illustrated folder with details and specifications will be sent upon request. Write National Equipment Corporation, Milwaukee, or see any of its district representatives.

Simplify Making Service Taps

A considerable saving in the number and cost of fittings is announced by the McWane Cast Iron Pipe Co., of Birmingham, due to the flexibilities of the McWane pipe-casting process (sand-cast), which permits the casting of bosses, collars, slabs, etc., on large as well as small sizes of McWane pipe.

Bell-Ends of Two 6-Inch 16-Foot McWane Pipe with Tapping Bosses

Tapping these bosses, etc., permits a threaded smaller-pipe connection direct into the larger pipe without employing a fitting. This applies particularly to the irrigating system for golf courses and to the intricate piping of filtration and sewage disposal plants.

The collars are cast on the 2 and 3-in. WcWane pipe in order that service taps may be made anywhere on the circumference of the collar, instead of taking care to bring the bosses to a point at the top of the pipe, or at a certain angle, when laying it.

Calco Spi-Weld Pipe

Calco Spi-Weld pipe is formed with a spirally welded longitudinal seam which results in a smooth interior and a regularly circular form. Considerable experimental production preceded its introduction to the consumer.

This pipe is now in service in the West and it is rapidly taking its place as an established product for the conveyance of gas, oil, or water.

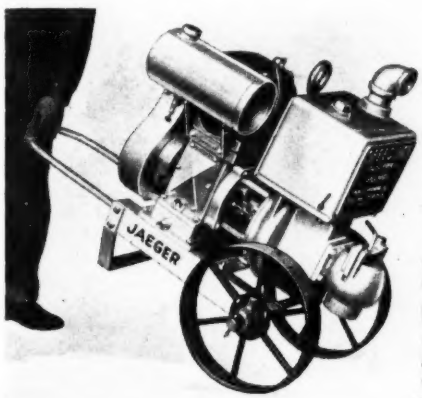
Employment of continuously rolled strip metal or of sheets or plates sufficient for 20-ft. lengths of pipe makes possible the almost complete avoidance of transverse seams. Field joints can be welded or made with Dayton type couplings, either method producing tight and firm joints with minimum interruption of flow. The result is a strong and practical line with a smooth interior and consequent high capacity.

Calco spiral welded pipe, after hydraulic testing to 1½ times the safe working pressure, is carefully dipped in high-grade asphaltic pipe coating. Care is taken to produce a protective coating as efficient and lasting as the present state of the art makes possible. After dipping, the pipe can be furnished wrapped with a standard protective wrapping.

Lowering 24-In. Calco Spi-Weld Pipe Into Trench. Line Is Wrapped with Soil-Proof Wrap

Jaeger Develops New Pump

Jaeger Machine Company of Columbus, Ohio, announce a new 2-in. self-priming, centrifugal pump. The capacity of this unit is said to be 10,000 gal. per hr. It is portable, compact, light and mounted on a one-man trailer.



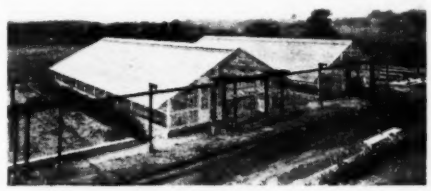
Jaeger Speed Boy Self Prime Pump

A 2 to 2½-hp. Wisconsin air-cooled 4-cycle motor equipped with Wico magneto furnishes the power. After initial priming the unit can be moved from one setup to another without losing its priming water. A lifting ring is attached for handling on pit work.

Glass Sludge Bed Covers

Lord & Burnham Company, New York, N. Y., announce recent developments in glass covers for sludge beds and sprinkling filters. A recent development of general interest and novel enough to attract attention, in the matter of ventilation, is a recent installation at Middletown, N. Y. This job was erected in the Fall of 1930. The engineers were Fuller and McClintock and the general contractors are R. T. & C. B. Stewart. The installation consisted of two covers each 40 ft. by 80 ft.

The principal feature of interest on this job, is the fact that the engineers felt it desirable to secure maximum ventilation. Cooperating with them in the accomplishment of this purpose, a design was worked out in which the bottom row of sash were swung in with the idea of deflecting the air down upon the bed. The upper row of sash were swung out with the double purpose of securing a full current of air along the roof and also with the idea of spilling the water off the roof far enough out so as not to be blown in on the bed through the inswinging lower line of sash.



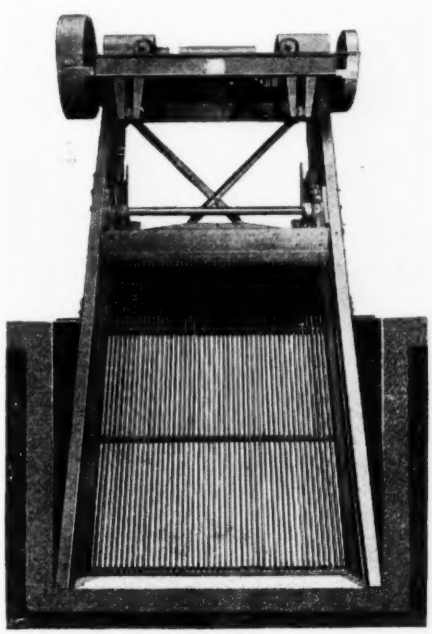
Glass Enclosed Sludge Beds

This treatment was not only carried out along the sides, but also across the gables. The ridge vents were of the conventional top hung outswinging type.

The operation is undoubtedly the most elaborate yet installed insofar as ventilation is concerned, and should be of particular interest to those engineers who are striving for maximum ventilation in glass sludge bed covers.

Straightline Sewage Screen Announced by Link-Belt

The Straightline screen consists of a rack made up of steel bars, usually set vertical or at an angle of about 60 deg. with the horizontal. The clear openings between bars may be made from ½ in. to 6 in., depending on requirements; and



Link-Belt Straightline Sewage Screen

the screens are made of any width from 3 ft. up to 15 ft., or more if desired.

The rack is cleaned by a rake, secured to a carriage, which travels back and forth over the screen bars. On the upward travel the rake engages with the rack and carries the accumulated solids up to the top of the screen. As the rake passes the top of the screen, a scraper cleans off the adhering solids into a trough or conveyor. It is then carried back, clear of the rack, to the bottom of the screen, where it is again lowered into engagement with the bars, for a repetition of the operation.

The speed of the rake is approximately 7 ft. per minute. By means of a time relay the rake is stopped at the highest and lowest position for half a minute. This time may be varied up to 30 minutes, to suit local conditions.

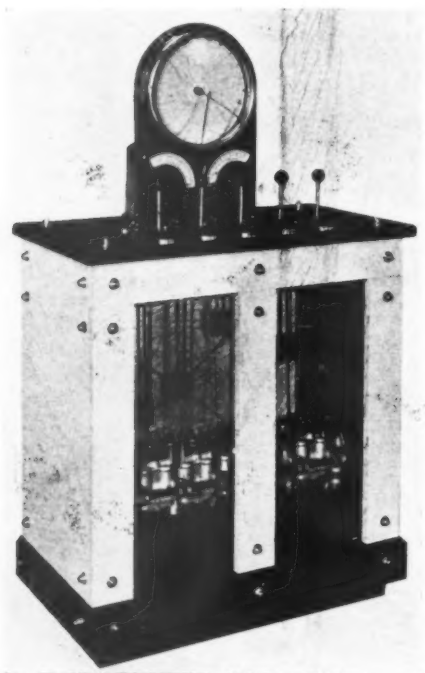
The outstanding feature of this machine is its ruggedness. Very heavy solids may be handled by it without any damage to the machine. Ample safety devices are provided to stop the machine if boards or any other heavy material should become jammed between the racks. Means are provided for adjusting the rakes in relation to the screen so that rakes do not ride on the screen.

One set of machinery can drive several units. If two units are used, the carriages are counterbalanced, one going up, while the other one comes down.

Link-Belt Sewage Treatment Plant Book No. 642 describes the unit. This book will be sent upon request.

Hydraulic Four-Way Switch Developed

International Filter Co. is showing a new type of four-way control valve for the manipulation of hydraulically operated valves. It is called the Hydraulic Four-way Switch to distinguish it from ordinary four-way valves or cocks, and it utilizes the positive seating action of four composition valve disks closing against ground seats. The front ports send pressure water to either end of the valve cylinder, and the two rear ports allow water returning to the valve cylinders to escape to waste. The disks are normally held to their seats by line pressure; a light pressure on the operating lever raises a single valve spindle through a rocker arm, causing the proper pair of pressure and waste ports to open or shut. A cross over body beneath the port distributes the pressure water to the proper connections in the hydraulic valve cylinder. When in the neutral position, this switch is absolutely water tight, as the composition disks prevent leakage past the ports. Disks are readily replaceable and no regrinding or lubrication is necessary. The switches are constructed of bronze and stainless steel, and are bolted together in a single row forming their own waste and pressure channels, eliminating the use of interconnecting piping or a cast iron header such as is ordinarily required. The top of each switch is readily removable for the replacement of disks without disturbing adjoining switches or pipe connections. There is no possibility of setting or sticking such as is experienced with the ordinary four-way plug cock, and the tendency to wear and leak so common in pilot valves is entirely eliminated. These hydraulic switches naturally find their greatest uses in operating tables for water treating plants, as they need much less attention and can be more closely spaced than ordinary control valves. They are also used in various other applications, such as pump control systems, and can be provided with solenoids for remote control operation. They are to be used in the new Detroit filter plant and are already in use in the filter plants at Niagara Falls, N. Y., Lockport, N. Y., New Orleans, La., and elsewhere.



International Filter Company's Hydraulic Four-Way Switch

Fundom Improves Trench Hoe

The Fundom Hoist and Shovel Company of Lima, Ohio, designed and built their digging unit to meet the demand of modern excavating practice. The new shovel and trench hoe has fewer parts to wear, consequently it requires less power to operate the mechanism, allowing more power for digging.

The power unit is a Fordson tractor with governor, and without wheels. The high tension magneto with impulse starter makes starting easy. It has excellent ignition, cooling and lubricating systems and large air washer. It has flexibility and an abundance of surplus power. Alemite high pressure system is used on all bearings. The clutches are double faced and lined with highest class facings. The boom is constructed of 8 in. channel reinforced with plates and ties. It is 12 ft. long. Two 6 in. channel members form the mast fastened to lower end on yoke casting; upper end supports mast head casting. The crowding mechanism is operated by double-pad special lined clutch, driving link chain to support shaft, which is provided with two steel, machine cut, pinions meshing with steel machine cut, racks on the dipper handle. Travel-

Improved Fundom Trench Hoe

ing speed is 2½ miles an hour. All high speed shafts have Timken roller bearings. Other bearings have phosphor bronze bushings.

The unit may be equipped with several attachments, the shovel being 1/3 cu. yd. capacity.

Sullivan Beautifies Air Lift

The Sullivan Machinery Company, Chicago, Ill., have made their Air-Made wells ornamental as well as dependable and economic. The concrete stand with plate glass windows, transforms them from merely good wells to beautiful fountains. The operator can tell at a glance just what each well is doing by looking through the window. The entire well head being made of concrete, steel and glass, is sanitary, and practically indestructible.

As Air-Made wells are pumped exclusively with Sullivan air lift pumping systems, there are no working valves, plungers, impellers, bearings, pump rods, or other moving parts in the well to be worn or cut out by sand. Incidentally, with this system there is no trouble experienced from varying water levels, or crooked wells. The Sullivan air lift system is made to order for each individual installation, and fits exactly the conditions encountered, so that the best possible results are obtained, from the standpoints of dependability and economy.

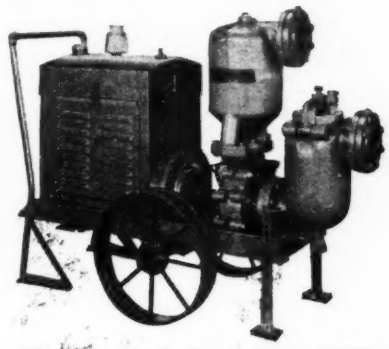
LaBour Type WPD Announced

LaBour self priming centrifugal pumps have the positive suction of plunger pumps combined with the large volume and structural simplicity of centrifugal pumps. The removal of air and the pumping of water is done with one pump and one impeller.

They pump air and prime themselves when starting with an empty suction line or when handling air with the water.

No foot or check valves are required.

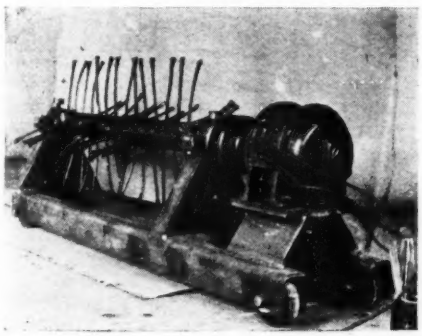
In presenting this newest LaBour product for the contracting field, the company states that they have taken steps to combine light weight and easy portability with the sturdy construction found in other LaBour pumps, and, like the others, this pump is guaranteed for a 20-foot suction lift. This new model is a 4-in. pump with a capacity of 400 gallons per minute at a 25-foot head, or 350 gallons per minute at a 35-foot head, it is claimed. The suction trap and separator are cast of aluminum.



The Newest LaBour, Type WPD

New Pipe Cleaning Machine

In the manufacture of water pipe it is very essential that the surface of the material used be cleaned thoroughly before coating is applied. Various systems have been used for accomplishing this. After careful experimentation the United Welding Co., Middletown, Ohio, found that the steel wire brush was the most dependable and thorough.



United Pipe Cleaner

Being unable to buy a brush the required size to make the necessary speed, they designed one of their own. This brush has a capacity of cleaning 5 feet wide with the pipe revolving in front of it at the circumferential speed of 25 ft. per min., making the capacity 125 sq. ft. of surface per minute.

This machine has enough force to throw a stream of sparks from the material as it is being brushed. The brush, itself, consists of four segments clamping ⅝ in. cable in rigid position. It is mounted on ball bearings supported by welded steel housing and driven by a 5 hp. motor at 1200 r.p.m.

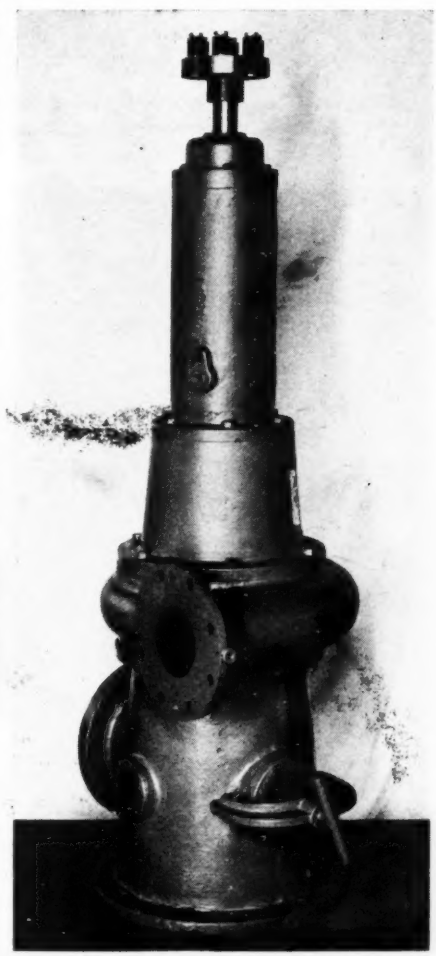
The pipe is revolved on a table with the speed reduced to a suitable point for good brushing.

This machine has worked very satisfactorily for a period of one year and there has been no upkeep, except, occasionally replacing the steel cables that form the brush. The whole unit is mounted on wheels that run on a track beside a 40 foot section of pipe. When one width of the brush is cleaned, it is moved 5 feet further along the pipe. This is continued until the pipe is finished.

New Sewage Equipment

Economy Pumping Machinery Co. of Chicago, Ill., announce a new vertical open shaft sewage pump with suction box base.

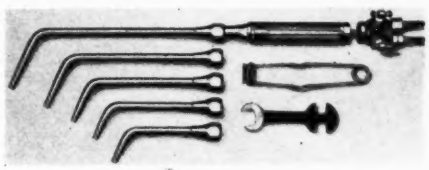
This pump is designed to pass solids closely approaching the size of the suction piping. It is equipped with quick acting clean out, which makes it possible to remove boards and similar material which may occasionally reach the pump. These pumps are made in complete ranging capacities from 100 to 10,000 g.p.m. against heads up to 120 ft. They are equipped with either ball or sleeve bearings and with vertical adjustments which make it possible to restore the original efficiency at any time.



New Economy Sewage Pump

Two New Prest-o-Weld Blowpipes

The Linde Air Products Company, 30 East 42nd St., New York, N. Y., has recently added two new welding blowpipes to its line of Prest-O-Weld medium pressure apparatus, presenting an entirely new idea in blowpipe design. A detachable valve body, to which the handle is secured by a simple and convenient locking device, enables the operator to change quickly from the standard to different handles without detaching hose or hose connections and without the use of a wrench.



Prest-O-Weld Type W-105 Welding Blowpipe

Designated as the Prest-O-Weld Type W-105 Welding Blowpipe and Type W-106 Welding Blowpipe, these two new additions to the line have been designed to give Prest-O-Weld users a medium pressure blowpipe comparable in range to the Oxweld Type W-17 welding blowpipe.

Both blowpipes are designed for use with new type, one-piece, hard drawn copper welding tips. Although regularly supplied with a head angle of 60 degrees, this may be changed by the user to any angle desired. Ten different sizes of tips, Nos. 4 to 13 inclusive, are available for use with the Type W-105 handle. The Type W-105 Blowpipe, as furnished complete, includes tips Nos. 4, 6, 8, 10 and 12. A stem adaptor is available so that tips for the Prest-O-Weld Type W-107 Aircraft Welding Blowpipe may be used with the Type W-105. This makes the new blowpipe adaptable for work ranging from the lightest sheet metal welding to heavy welding work requiring a No. 13 welding tip.

The Prest-O-Weld Type W-106 Blowpipe is similar in design to the Type W-105, but smaller. It is supplied with five sizes of tips, Nos. 3 to 7 inclusive, which cover a wide range of usefulness. The Type W-106 Blowpipe is particularly suited to automobile repair shops for general light welding, bronze-welding small parts, and for soldering. It is also suitable for sheet metal plants in production work. A stem adaptor is available so that Type W-107 tips may be used with the Type W-106 handle.

New P&H Machines

Harnischfeger Corporation announces a new ⅜ yd. excavator now being put into production in its plant at Milwaukee to be ready for spring delivery; also, a new double head tamper.

This new machine, known as the Model 200-A, follows the same general design of the larger P&H's. It is sturdily and compactly built with a large proportion of alloy steels and is light enough to meet the demand for a convertible excavator weighing under fourteen tons. Hoist, swing, crowd, and travel speeds are unusually fast.

Corduroys (crawlers) employ the P&H double sprocket drive on link pins instead of the links themselves. All machinery on the revolving frame is placed with a view to compactness but with full accessibility. Drums are mounted on separate shafts with the jack shaft assembly between. The entire gear train

New P&H ⅜-Yd. Excavator

is located on the right side of the machine and runs in an oil bath. Shafts operating in excess of 40 r.p.m. are roller bushed. All clutches are of the internal expanding type. Hoist and crowd clutches are interchangeable, as well as the five main outside type brake bands. Boom hoist is of the planetary type with automatic safety load brake.

A four or six cylinder 45 hp. gasoline engine furnishes power and provides ample acceleration and speed.

The patented P&H chain crowd appears on the Model 200-A in a highly perfected form. The dipper can be returned at more than twice the speed it is crowded out. Raising and lowering the boom does not disturb the adjustment of the crowd chains.

The P&H Model 200-A shovel is standard with a 17-ft. boom and 12-ft. dipper sticks giving a total dumping height below door of 17 ft. The dragline and crane booms are of lattice box section design with a standard length of 30 ft. The machine is fully convertible for shovel, dragline, clamshell-crane, trench-hoe, or skimmer-scoop operation.

An outstanding feature of the Model 200-A is its ease of operation. By means of power clutch control and very responsible brakes, the machine can be manipulated as easy as an automobile.

A substantial fully enclosed steel cab is standard equipment. The entire machine is finished in a durable black green enamel.

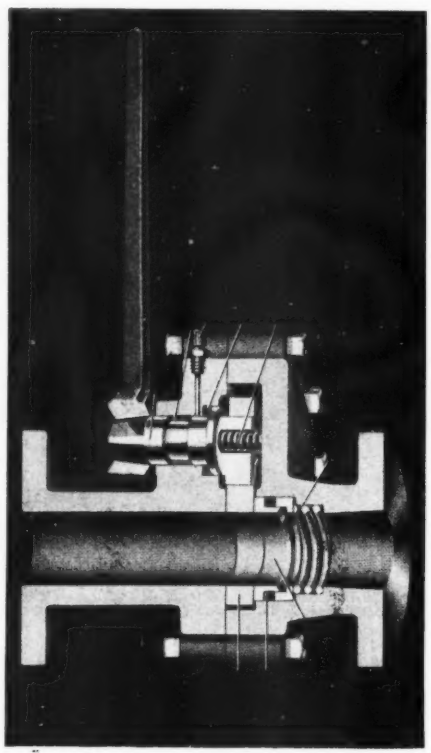
The new P&H tamper is equipped with two tamping rams weighing 150 lb., which are lifted and dropped alternately. Each ram delivers 45 blows a minute. The tamping rams can be traversed right or left at the will of the operator by means of a hand wheel.

With two tamping rams working, a minimum ditch of 18-in. width can be tamped. The maximum width is 36 in. The machine is designed to straddle trenches of varying width by means of sliding wheels adjustable between widths of 72 in. and 89 in.

Yarway Pretite Valves Announced

New Yarway Pretite valves, which have recently been developed for general service use, are somewhat similar to the Yarway Tightening valve, of the quick opening, lever operated, swing gate type having a straight through flow and the unique feature of a new two piece sealing bushing on the inlet side so that, as its name implies, it is "pre-tight."

The new two-piece construction of the sealing bushing provides a positive, automatic packing adjustment. A heavy corrosion resisting spring keeps the sealing bushing up against the disc or gate when no pressure is applied; the sealing bushing is forced up tight against the machined surface of the gate by the line pressure, this pressure being applied only on the annular disc; the sealing bushing is continually "ground in," just as the opposite face of the one piece solid disc is ground in as it passes across its seat. This solid disc or gate is in positive contact with its two seats during the entire opening and closing cycle.



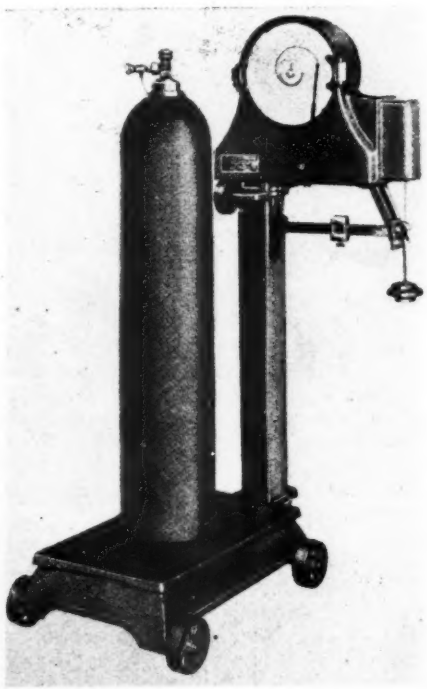
Flanged End, All Iron Yarway Pretite Valve

The Yarway Pretite valve is fully lubricated by means of Alemite fittings, with the grease properly guided to the sliding surfaces. These valves are made in various materials and in sizes from ½ in. to 4 in. inclusive.

W & T Chloro Scale Records Flow by Loss of Weight in Cylinders

Responsibility for proper chlorination is every day becoming heavier in water works and sewage plant practice. Permanent records of chlorination, automatically taken, are indispensable to correct and efficient operation.

The W & T Chloro Scale automatically provides charted records of chlorine flow



W & T Chloro Scale

that are valuable to the water works operator in the event of law suit. In addition, the scale establishes itself as a valuable tool in future studies of plant operation and stimulates accuracy of control on the part of plant superintendents at all times.

The W & T Chloro Scale is a recording loss of weight chlorine scale which records the rate flow as well as indicating the amount of chlorine fed over any given period of time. It is furnished to meet any requirements up to and including 5,000 lb. This range adequately services the smaller plant using one cylinder of chlorine at a time or the large plant using batteries of eight or ten cylinders—or ton containers.

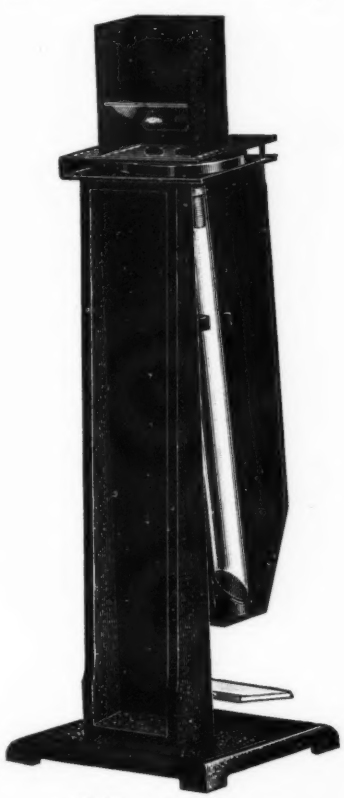
The complete Chloro scale is carefully finished in an attractive duco gray.

Technical Publication No. 78 of the Wallace & Tiernan Co., Inc., Newark, N. J., gives specifications and tells how the Chloro Scale operates.

Hellige Aqua Tester

The Hellige Aqua Tester consists of a substantial "U" shape upright on heavy iron base. Attached to the upper part of the upright is a platform with hinged cover for holding a color disc with color glass standards for the various methods. A light shield of proper height to keep off interfering light rays, and thus facilitating the color match, is mounted on the hinged cover of the platform and has brackets for a removable mirror. The latter enables the worker to observe the color fields conveniently from a horizontal eye position. Without the mirror the observation of the color fields can be made viewing from the top vertically through the apparatus. Brackets are provided, so that the mirror can be used in different height positions, depending on whether the Nessler tubes are applied or special cells of 13 and 40 mm. liquid depth for hydrogen ion control, for higher concentrated chlorine solutions or other tests. Mounted on the lower part of the upright is a platform with two sockets for holding the Nessler tubes, and in the middle are spring clips for the same purpose. This arrangement makes it very convenient to insert and remove the filled tubes. A large light shield is provided in front of the Nessler tubes in order to protect the solutions against direct light rays. A white opaque glass reflector serves for the illumination of the liquids in the Nessler tubes or cells.

The color glass standards are conveniently arranged in a circular frame of almost unbreakable material, thus forming the "Color Disc." By revolving this disc the proper standard is brought into the observation field. The Color Discs are of convenient size, 85 mm. (3½ in.) in diameter, and overcome the unhandy, slippery and easily breakable glass tubes with liquid standards in sets from which the single standards have to be put individually in the apparatus in order to select the proper standard.



Hellige Aqua Tester

Wemlinger Develops Corrugated Sheeting

Wemlinger, Inc., New York City, have developed a new corrugated interlocking steel sheet piling.

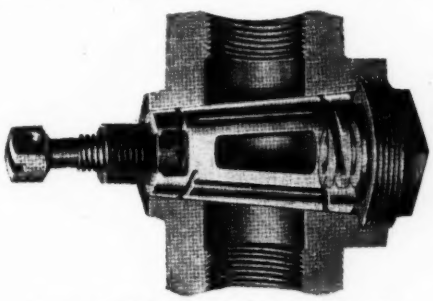
When an excavation is made in wet soil and must be kept free from water, it is highly advisable to use steel sheet-piling rather than wooden sheeting. The

Note Short Clips on Wemlinger Sheeting

corrugated steel sheets overlap and fit together closely, producing a tight interlock. Yet the short locking clip makes installation comparatively easy. Contractors who have used Wemlinger sheeting for cofferdams or other wet excavations express complete satisfaction with it. Besides being watertight, this sheeting has many other advantages which the company will be glad to explain.

Walworth Lubricated Service Cocks

The Walworth Lubricated Service Cock is made of Walworth Steeliron, carefully machined and fitted for tightness; set-screw lubrication, full lubricant grooves and a rust-proof steel spring under the plug. It has a solid, Steeliron bottom cap screwed into the body to a shoulder without makeshift adjustments or trimmings, sealing the valve tight with corrosion-resisting, durable Steeliron.



Style A Walworth Lubricated Service Cock

Style A is intended for general service where a low-pressure lubricated service cock is desired. It has set-screw lubrication which is simple to operate. It is generally used in standard type service boxes, either with or without extensions for lubricating or operating.

The principal feature of the Walworth Lubricated Service Cock, Styles B and C, which is patented and which is exclusive with the Walworth Company, is the threaded hub on top of the body which permits the user to put a length of pipe exactly suited to his ground conditions, screw the pipe into the body, put a cap on the top of the pipe at the surface of the ground and have a completely enclosed valve protected from water, dirt or gas leakage. Under no circumstances can the gas leak out or water and dirt leak in. This extremely important and economical feature is combined with the special service cock key, the end pieces of which are furnished so that the operator can attach a piece of pipe of the length necessary to suit his average ground conditions. This key arrangement, in addition to turning the valve on or off as desired, enables the operator to release the plug from the seat if, after years of non-use, it is stuck, by a tap from a hammer on top of the operating key, loosening the plug and permitting easy operation.

Wallace & Tiernan Ammoniator

The increasing use of the chlorine ammonia process for the prevention of phenol and certain organic tastes and odors in water supplies is being given extensive investigation today.

Recognizing the need for accurate and dependable control apparatus, Wallace & Tiernan, Newark, N. J., have developed the MDPA and MDWA ammoniators. This apparatus embodies all the experience they have gained in 17 years association with gas control; it follows very closely the design of their direct feed chlorinators, though certain modifications and changes have been necessary to adopt this apparatus to the feeding of ammonia gas.

W & T Ammoniator

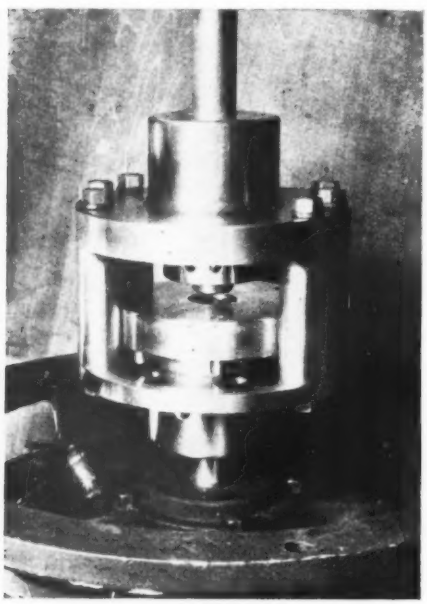
The MDPA ammoniator is a self-contained unit and can be installed anywhere. The WDWA ammoniator is made in two forms, one for mounting on the wall at a place convenient to the point of application, the other is adaptable for mounting on the standard Wallace & Tiernan Type MDP or MSP chlorinators.

The apparatus is rugged, well constructed and handsomely finished. It is guaranteed to accuracy of 4 per cent.

Ideal Vertical Pump Couplings

The Ideal Electric & Manufacturing Company of Mansfield, Ohio, has introduced a coupling for use with deep well pumps and vertical motors which enables a considerable saving to be made, not only in the original cost of the installation but in maintenance and upkeep as well.

Due to mechanical difficulties involved in building hollow shaft motors, these motors have been built only in the squirrel cage induction type, and no slip ring or direct current motors have been made. However, it is often desirable to use these types of motors, and the Ideal coupling enables any type of standard motor to be used in the well. Thus this coupling not only saves the difference in cost between the standard solid shaft motor and the special hollow shaft motors, but also enables the type of motor to be used which is best suited for the particular installation.



Ideal Vertical Pump Coupling With Drive Pins Disengaged on Back Spin Release

The other saving introduced by the Ideal pump coupling is in reduced maintenance costs. When the motor must be removed for pump maintenance or replacement, with hollow shaft motors, the motor must be jacked up high enough to clear the end of the pump shaft, a distance from three to eight (3 to 8) feet, depending upon the size of the motor. Also great care must be taken to maintain alignment when the motor is being raised, or else the pump shaft will be sprung. This job alone with a large motor takes considerable time and is expensive. Using the Ideal coupling, the motor is raised only high enough to clear the coupling and base, a matter of a few inches. No care need be taken to maintain alignment, either. The saving in time and expense is evident.

The Ideal vertical pump coupling is made in two types, one with back spin release and one without this feature. The coupling without the back spin release provides for thrust in both up and down directions, which is required in some installations.

The Ideal vertical pump coupling with a back spin release prevents a back spin from unscrewing the shaft sections. In normal operation the lower sides of the pump rotors clear the pump bowls by a small fraction of an inch. When back spin occurs and a joint in the shaft has started to unscrew, the shaft lengthens. The result is that the lower end of the shaft drops until the pump rotors ride on the pump bowls. Further lengthening of the shaft caused by continued unscrewing action of the back spin causes the upper end of the shaft to rise. When it has been raised to about ½ inch, the drive pins on the coupling are disengaged and the pump shaft then turns freely, preventing any further unscrewing of the shaft joints. Thus the back spin release acts before any joint can unscrew far enough (about 1½ inch minimum) to come apart. This feature is found only in the Ideal vertical pump coupling with back spin release.

Ideal Electric & Manufacturing Company will be very glad to supply anyone interested with further bulletins and details on the construction of these couplings.

New pH Equipment—The Slide Comparator

As a result of their long and varied experience with pH control equipment and methods, W. A. Taylor & Co., 870 Linden Ave., Baltimore, Md., has developed the new slide comparator.

The slide comparator consists of two principal parts, the slide and the base. The slide is a Bakelite case 10 in. long, 2¾ in. high and ⅝ in. thick. It contains 17 vertical holes and 17 horizontal slots which pass through the exact centers of the soles. In these holes are placed the 9 color standards for any given indicator and 8 ampoules of distilled water. All these ampoules are held in place by a lid which is screwed on the top of the slide.

The base consists of two parts. The lower part contains a slot in which the slide may be moved back and forth, two holes containing vials of indicator solution, five holes containing test tubes, and a closed compartment for a ground glass plate. Vertical slots run through the three central holes in the base holding the test tubes, these slots corresponding exactly with any three of the slots in the slide. The ground glass is contained in a closed compartment directly behind the three slots in the base. The upper part of the base serves as a cover for the vials and test tubes when the set is not in use. It is fastened to the lower part by means of spring catches.

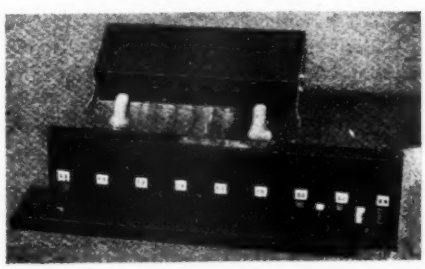
In making determinations, the top is removed from the base, three of the test tubes are filled to the mark (5 cc.) with the sample to be tested and placed in the three holes back of the slots in the base. To the central tube 0.5 cc. of the indicator solution is added by means of the pipette and nipple and the contents are thoroughly mixed. The slide containing the color standards is now placed in position on the base and, holding the instrument toward a window or other source of daylight, the slide is moved back and forth in front of the test samples until a color match is obtained. The pH is then read off directly from the values on the front of the slide.

Being molded from Bakelite the slide comparator is unaffected by water, acids or alkalis. It therefore will not warp or come apart. Molding also gives it a machined precision that is impossible with wood or sheet metal.

Since the color standards are enclosed in a Bakelite case, there are no loose standards to be inserted and removed in making pH determinations. Thus all chance of loss or breakage is eliminated. All color standards and test tubes are 11.5 mm. outside diameter. This small equipment makes the set small and compact and therefore readily portable. Of far greater practical importance, however, is the fact that the resulting thinness of layer of material being tested enables one to make accurate determinations on far more highly colored and turbid materials, without dilution.

The fact that determinations are made simply by sliding the color standards in front of the test sample until a color match is obtained makes the operation of the set extremely simple so that it is possible to teach a workman to use the set accurately with a few minutes instructions.

Slide comparators are supplied to cover the pH range 0.2-13.6. Each comparator covers a range of 1.6 pH units, the standards being in intervals of 0.2 pH.



New Slide Comparator

The long range slide comparator was designed to meet the need of those workers who require a portable set covering a wide pH range. This set is made in five models (T-3, T-4, T-5, T-6 and T-7) to cover the range of any 3, 4, 5, 6 or 7 indicators, respectively, between the limits of pH 0.2 and 13.6, the number after T indicating the number of indicators included in the set.

Each long range slide comparator contains one complete slide comparator; 2 to 6 extra color standard slides; vials of the corresponding indicator solutions, with pipettes and nipples; and a supply of 5 cc. test tubes. This equipment is contained in a portable case 11 in. long, 9½ in. wide and 4½ in. high.

Improved Speeder ½-Yd. Shovel

The Speeder Machinery Corporation, Cedar Rapids, Iowa, has announced recently improvements in the crawlers and driving mechanism of the Speeder Model B3 of ½ yd. capacity.

The new type crawlers and driving mechanism are designed especially to eliminate friction and to expedite the repair and adjustment of the traction shaft while on the job. The new crawlers are of the lug driven type, 16 in. in width and are hinged by three eyes. A roller idler now replaces the idler sprocket on the front of the crawlers. All crawler carrier trunnions and return rollers are bronze bushed. The traction shaft is splined and no keys are used. It is supported by four heavy bronze bushed split bearings, and is in three separate shafts, rather than one long shaft, which allows the man on the job to quickly remove any part for adjustment or repair. The travel gears are machine cut, heat treated, case hardened, and run in grease.

The Speeder Whirlwind of ⅜ yd. capacity, the Speeder 90 of 1¼ yd. capacity, and the Speeder B3 of ½ yd. capacity are now equipped with crawlers and crawling mechanism of the same type.

Young Improves Boring Machine

The Young Road Crossing Boring Machine is fundamentally a horizontal rotary drill, using the pipe or casing that is to be installed and which remains in the ground when the job is completed as the medium for carrying the rotating cutter head.

In operation the boring machine is placed in the ditch and the power unit is set up on the bank at the side. Power is transmitted by means of an adjustable drive shaft with universal joints to the upper sprocket of a chain and sprocket drive on the boring machine which can be set at the desired height. This system of power transmission is flexible and adjustable to all operating conditions.

The pipe or casing to be installed is bolted to the rotating hollow driving sleeve by means of the 8x13½-in. forged steel pipe flanges.

Young's Boring Machine at Work

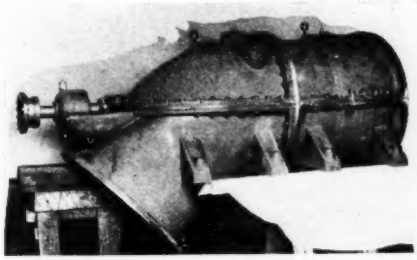
A suitable cutter head is attached (usually welded) on the forward end of the casing.

The rotating hollow sleeve is forced forward by jacks and the rotating power is applied to it by means of a worm gear reduction. The combined rotating and forward motion of this sleeve forces the pipe into the embankment. Dirt is removed through the hollow sleeve by means of a spoon attached to a long pipe handle, or by water, where conditions are favorable.

After the casing has entered the embankment a distance of about 6 ft., or, in other words, when the rotating hollow sleeve has advanced forward to its full extent, the flange of the driving head is unbolted from the pipe or casing and a 5½-ft. flanged "pup" or extension joint is inserted between the rear end of the pipe and the flange of the sleeve, which has been backed to starting position. This cycle of operations is continued until the entire pipe or casing has been installed.

Worthington Announces Propeller Pump

Worthington has developed an improved propeller pump known as Type K, which is the result of continued research to produce pumps for low head applications that will compare favorably in efficiency with that obtained for higher head service. As is shown in the illustration, the pump has a cylindrical casing and the suction and discharge elbows are bolted to flanges at each end of the casing. It is the usual practice to drive the pump through the discharge end but in some locations it is preferable to drive through the suction end.



Worthington 42-K Drainage Pump

The propeller shaft is supported on two bearings; an internal grease lubricated bearing which is located close to the propeller, and a combined radial and thrust bearing of the anti-friction type mounted on the elbow.

The internal bearing is supported in a spider inside the pump cylinder, on the discharge side of the propeller. The vanes supporting the bearing housing also function to guide the water leaving the propeller.

An important feature of the Type K pump is the form of the propeller. The hub is of a relatively small diameter, and the number and shape of the blades is such that the clearance between blades permits the passage of trash without clogging the pump. Trash cutters which are frequently employed with pumps of similar type are therefore unnecessary.

The Type K pump can be arranged for either horizontal or vertical shaft drive. For the vertical shaft arrangement a 90° discharge elbow is usually employed and a suction bell mouth is attached to the bottom flange of the pump casing.

A New Chlorine Diffusing Device

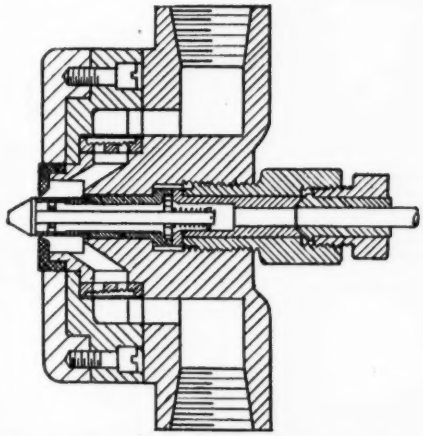
The Paradon Mfg. Co. of Arlington, N. J., announces the development of a chlorine diffusing device known as the Paradon impulse type dry feed diffusor.

With the impulse type dry feed diffusor, the gas is applied directly to the water or sewage. However, instead of depending on bubbling towards the surface for absorption, a stream of water under high velocity is played on the rising bubbles of gas. This stream is stated to accomplish four purposes: It causes the gas bubbles to take a horizontal path instead of a vertical path, thereby greatly increasing their contact with the water or sewage into which the gas is applied. Second, the high velocity stream minutely divides the bubbles; this action enormously increasing the area of contact between the gas and the water or sewage. Third, the size of the gas bubble being much smaller, its buoyancy is very much less and it therefore will rise to the surface at a slower rate and again more contact with the water or sewage is obtained. Fourth, the high velocity stream of water produces violent agitation of the water or sewage adjacent to the point of gas application; once more effecting a greater contact between the gas and the water or sewage.

The manufacturers cite following table of typical results accomplished by the impulse diffusor:

Water Supply (in gals. per min.)	3	4	5
Submergence of Impulse Diffusor (in feet)	Chlorine (pounds per day)		
1	275	350	450
3	350	500	750
5	500	650	750

It is stated that sewage or other liquids



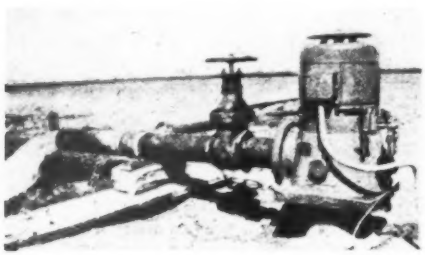
The Paradon Impulse Type Dry Feed Diffusor

could also be used to operate the impulse diffusor, if desirable.

It is further stated that at one installation using impulse diffusors, 200 lb. of chlorine per 24 hours were applied. The water required to operate the diffusor in this case amounted to only 360 gal. per hour.

Timken-Equipped Wintroath Deep-Well Pump

Wintroath Pumps, Ltd., of Alhambra, Calif., announced a new line of anti-friction bearing-equipped deep-well turbine pumps that have several interesting points. The line includes pumps of capacities ranging from 25 to 6,000 g.p.m. and the ratings range from 3 to 400 hp. The standard pumps are directly driven by an electric motor, but they may be modified for belt drive by gasoline or oil engines. The line is especially suitable for work on irrigation systems, municipal water-supply systems, industrial water supply, or domestic systems such as farms, private estates, and and similar cases. They can be used on either shallow wells, or those exceeding 500 ft. in depth, where the internal diameter of the well is 6 in.



Wintroath Deep Well Pump Turbine Pump Directly Driven by Electric Motor

or over. In addition to lifting they may be used as boosters against any desired pressure above ground.

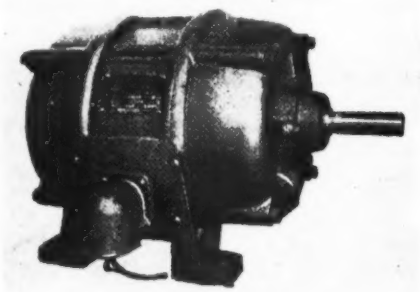
The construction is quite simple, the pump consisting of two main parts, the head, and the impeller mechanism, or pump proper. The former consists of a cast-rotor squirrel-cage vertical-type induction motor, which is connected to the impeller mechanism by a sectionalized line shaft. The motor is designed for across-the-line starting, so that the control consists simply of a start-and-stop push-button station that can be located at any convenient point. The weight of the motor rotor, shaft and impellors is carried by a Timken thrust bearing mounted on the lower end of the rotor shaft. Another anti-friction bearing is used as a guide bearing at the upper end of the shaft. One of the interesting features of the head is the lubrication system that has been adopted. There is an oil bath or reservoir surrounding the Timken thrust bearing, and located so that it extends downward into the discharge chamber of the head. Thus the oil is kept at constant temperature by the cooling action of the discharged water. Oil from this reservoir is pumped to the upper, or guide bearing, whence it flows back to the reservoir. This continual circulation of cool oil not only prevents any possibility of overheating, but greatly lengthens the effective life of the lubricant.

The head is connected to the pump by a line shaft consisting of 10 or 20-ft. sections of Cumberland turned and ground shafting coupled together. It is carried in phospher-bronze line-shaft bearings spaced about 6 ft .apart. This construction makes it a simple matter to lower the pump to follow a retreating water level. The pump proper is of the multi-stage centrifugal type, totally enclosed. The impeller is both hydraulically and dynamically balanced, and extra long bearings have been provided. The intermediate castings, which make up the stages, are equipped with replaceable bronze bushings at the point where the impeller shaft passes through them. The pump is provided with a suction strainer consisting of galvanized half-round wire wound flat side out around a conical steel framework. The construction is such that gravel or similar foreign matter cannot lodge in the openings. Suction pipe can be furnished in any desired lengths.

New Electric Motor

The Ideal Electric & Mfg. Co., Mansfield, O., developed a complete series of electric motors, claimed to represent a radical departure from the ordinary type and design familiar to users of electrical power units. The new motors present many new design features of considerable interest. By placing the motor feet on the bearing brackets all load shocks and strains are carried directly to the motor support. Shock loads or vibration will not affect the live elements or weaken the assembly of the motor. Since the bearing brackets support themselves the only mechanical load on the stator is the motor torque. When the front end bracket and stator are removed, the pulley end bearing bracket remaining bolted to the base will still support the rotor and gear, pulley, or other connection to the driven machinery. This allows cleaning and examination in much less time than usual and without disconnecting the drive gear or pulley.

The motors are made as standard squirrel cage induction motors, slip ring induction motors and direct current motors in all types of mechanical construction and electrical characteristics. The squirrel cage induction motors are made in four standard designs as regards starting torques and starting currents. Special designs are made to suit any set of specifications.

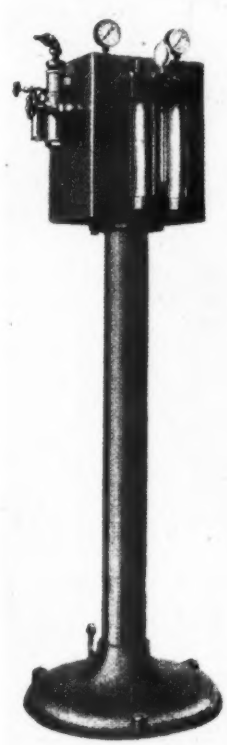


Ideal 5 HP Ball Bearing Motor

All unit type motors are designed to meet the standard torques, power factors, efficiencies, heating specifications, dielectric tests and other performance guarantees and also the uniform mounting dimensions established by the National Electrical Manufacturers' Association. They are furnished in sizes from ½ to 200 hp.

Chlorinator for Small Water Works

A chlorinator designed to handle small amounts of chlorine for small water supplies has been developed by Wallace & Tiernan, Newark, N. J. It is stated that not only does the machine accurately control the small amount of chlorine necessary but its simple construction is readily understood by the practical water works men. All control parts are on the out-



W & T Chlorinator

side and a removable hood makes possible complete inspection at any time.

Reliefs are provided to prevent moisture being drawn back into the chlorine gas control parts, and also to prevent escape of gas into the room in the event of accidental failure of the auxiliary water supply operating the equipment. The machine is also adapted to the small sewage disposal plant. Technical Publication Number 74 of the Wallace & Tiernan Co., Newark, N. J., gives specifications and descriptions of the equipment for small water supplies. Copies will be sent on request.

New Sealing Compound

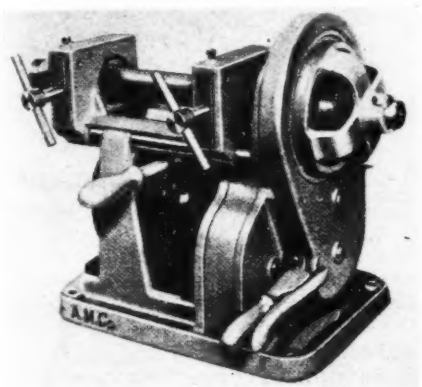
The Quigley Co., Inc., New York, N. Y., manufacturers of Hytempite and Triple-A protective coatings, announce the manufacture of a plastic, expansive compound for sealing joints, called Q-Seal.

A micaceous mineral having expansive properties is ground to a very fine mesh and used as the principal pigment in the compounding of Q-Seal. The principal vehicle or mixing agent used is one that is impervious to crude oils, all of their derivatives, acids, etc., and is non-corrosive.

Q-Seal is easily applied to joints to be sealed with a brush. The expansive qualities fill any imperfections in threads, flanges or gaskets. The compound seals joints leakproof, and prevents rust and corrosion.

New Pipe-Threading Machine

A new pipe-threading machine, designed for a wide range of uses, has been developed by the Axelson Mfg. Co., Ltd., Los Angeles, Calif. Its operation is simple and the machine occupies a minimum of space, according to the manufacturers. The pipe that is to be threaded remains



Axelson Pipe-Threading Machine

stationary while the standard square die is revolved, cutting the thread. This differs from many other types that require revolving of the pipe. Long stands of assembled pipe or bent pipe may be conveniently threaded as it is unnecessary to rotate the units. The work is gripped by two jaw chucks which are practically automatic and instantaneous in action. Standard square dies, obtainable from practically any supply house, are readily adapted to the cutter thread. Threads can be cut on material from ½ to 2 in. in diameter and the power is supplied from a ½-hp. compound-wound motor, installed directly beneath the pipe-holder brackets. Electric current of 110 or 120 volts, either 50 or 60-cycle, may be applied.

The manufacturer claims that the threader will cut at the rate of 17 r.p.m. on all sizes from ½ to 2 in., and the required time for completing 11 threads is about 40 seconds. After the thread is completed the dies are reversed, and during this operation rotate at 34 r.p.m. Attachments are available for the cutter head to permit cutting off, reaming and bolt making.

Spiral Welded Pipe

A spiral welded pipe is the latest development of the American Rolling Mill Co., Middletown, O. In the fabrication of this pipe long coils of iron or steel strip are placed in a decoiling device on one end of the pipe machine, which is one compact self-contained production unit. There the coil is unwound and flattened. Then it proceeds through the forming rolls and is welded. The spiral seam is produced by feeding the strip into the machine at an angle of approximately 45 degrees. The great length of the coils or metal eliminates the necessity for frequently stopping the machine to add new stock. A cut-off mechanism synchronized with the speed of the welded pipe assures accurately gaged lengths.

The pipe is manufactured in jointless lengths up to 40 ft. and can be supplied in sizes ranging from 6 in. to 24 in. in diameter, in any wall thickness from 12 gage to ¼ or ⅜ in. It can be furnished with any type of coating desired—mill coat, asphalt inside or out, or galvanized.

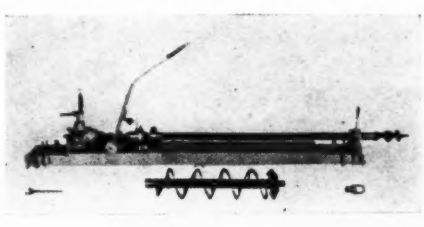
A modern pipe manufacturing plant has been established in Armco's Central Works at Middletown, O.

New Boring Machine for Installing Pipe

The Hydrauger a patented pneumatic-hydraulic auger, has been used for several months with practical success in Marin County, California, and other parts of the San Francisco metropolitan area, demonstrating that it can bore under wide thoroughfares without the necessity for trenching. Automobiles have rolled unimpeded over the surface of the Redwood Highway, for instance, while the boring was being made beneath for the placing of 3-in. pipe. It is claimed that this machine will eliminate the tearing up of streets and highways for placing pipes and conduits.

The Hydrauger is notable in that an operator can direct its bore with the precision of a marksman, according to the manufacturer, at distances of 40 ft. bringing it out to within 2 or 3 in. of the point at which it is aimed. The machine is capable of boring at distances of 100 ft. or more without the necessity for trenching.

Not only does the use of the Hydrauger obviate the necessity for cutting up streets and highways, but it also is used for laying pipe under gardens and buildings, without disturbing the top soil.



The Hydrauger

The machine is driven by compressed air and connected with running water, which passes through the boring-bars, issuing in two streams at the auger. The water washes the borings back, incidentally acting as a lubricant, and leaves a clean, straight hole. So little water is used that it can be obtained by connection with an ordinary domestic faucet or, if necessary, a fire hydrant. 30 lb. pressure is sufficient.

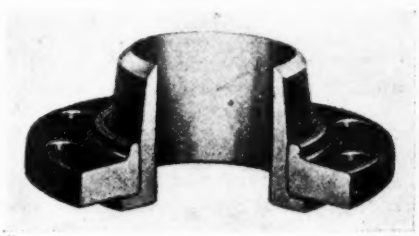
Where no piped water is available water may be transported in a barrel and circulated by means of a small air-driven pump. So little water is used that it can be left in the ditch, or bailed out by the operators with small effort.

Feed ahead is accomplished by a simple and strong reversible ratchet. After a boring is completed the permanent pipe may be pushed in by hand or the machine ratchet may be used to pull in either the permanent pipe or a cable. A swivel is furnished with each machine for this purpose.

The machine has been developed by the Hydrauger Corporation, Ltd., 1298 Bryant St., San Francisco, Calif.

New Flanged Joint

A new type of flanged joint has been developed for use in connection with welded pipe lines where such a joint is required for the insertion of valves and fittings for the taking off of outlets. It is known as the "Merco" swivel flange. It



New Flanged Joint

consists of a drop forged steel flange, fitted to a drop forge tapered nipple on which the flange may be rotated, permitting alignment of bolts, etc. The tapered nipple is forged from a solid steel billet and the finished product incorporates a thickness much greater than pipe at the base of the nipple where highest stress occurs. Being formed completely at the proper forging temperature, possibility of a fracture of the metal is minimized. The manufacturers state that by forging from a solid billet sufficient heat is stored up in the steel to permit operation being finished at the correct forging temperature.

An advantage of this swivel flange lies in its flexibility, having equally as much as the ordinary Vanstone type of flanged joint. The manufacturers are arranging production to soon make available sizes from 1½ in. to 10 in., and specifications are to meet the American standards in strength requirements.

This new product is made by the Merco Nordstrom Valve Co., 343 Sansome St., San Francisco, Calif.

New LaMotte Utility pH Outfit

The new indicator covers a very wide range exhibiting sharp color changes throughout. A single indicator of this type has long been sought. It provides everything that is required for control work in the industries. The colors exhibited by the LaMotte Utility indicator color standards used in the set are virtually those of the spectrum and range from bright red at pH 3.0 through orange to yellow, to yellowish green, to green, to greenish blue, to blue and to purple at 10.5. The color standards are in integers of 0.5 pH.

With this unit it is possible to make pH determinations over the range pH 3.0-10.5 with an accuracy of 0.25 pH. Actual tests on highly colored and turbid solutions and liquors from industrial plants have shown that the new LaMotte Utility Indicator is suited for virtually every type of work.

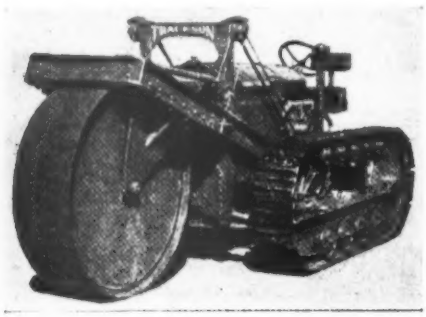
Coupled with the unusual flexibility of the indicator itself, one will find great advantages in the fact that this particular outfit may be used both for central laboratory and plant control work. Facilities are provided so that quick tests may be made in any part of the plant with the Block Comparator, which serves as a combination pH reader and containing case for the marked test tubes and the indicator solution. The LaMotte Utility pH outfit may be plugged into any available socket and is ready for immediate use.

New Trackson Trench Roller

An interesting recent development in construction equipment is the new Trackson trench roller, illustrated here, which provides a simple, effective and economical method of packing down dirt over newly-laid cable, conduit or pipe line. This roller is manufactured by the Trackson Co., Milwaukee, Wis.

This roller is built for mounting on the Model DH Trackson McCormick-Deering crawler-tractor, as shown in the illustration. It consists of a wide steel roller filled with concrete, which weighs from 3,000 to 4,000 lb., the weight varying to meet the requirements of different soil conditions. For average jobs a 3,500-lb. roller is recommended.

Interchangeability is a feature of Trackson front-end tractor equipment, and since the mechanical hoisting assembly of the trench roller is identical with that of the Trackson shovel and the Trackson bulldozer, it is an easy matter to detach any one of these attachments and mount another in its place. In this way a single power unit may be used for a number of purposes.



Trackson Trench Roller

This outfit may be used for rolling over all kinds of underground lines without damaging the cable or casing, provided, of course, that sufficient dirt is thrown over the pipe before it is rolled. The first layer should be from 10 to 20 in. in depth, depending on the nature of the soil, and the rest of the dirt is usually rolled in 6-in. layers.

Orthotolidin Test Controls Chlorine in New W & T Chlorinator

An entirely new principle in automatic control of chlorination—developed by Wallace & Tiernan research engineers—is discussed in a paper, "Operating Experiences with a New Automatic Residual Chlorine Recorder and Controller," read before the recent annual convention of the A. W. W. A. It has been reprinted as Technical Publication No. 135 and copies may be had by writing Wallace & Tiernan Co., Inc., of Newark, N. J.

The orthotolidin test, generally accepted as the criterion or correct chlorinator operation, positively controls chlorine flow with this apparatus. The tests are automatically made at ten minute intervals and "residual chlorine" of the treated water recorded on a chart.

Any fluctuations in flow or chlorine demand are reflected in varied "residuals" and immediately compensated for by the automatic controller. Recorded "residual chlorine" curves show no appreciable lag between chlorine demand and automatic adjustment of chlorine flow.

This apparatus is available as a full automatic "residual chlorine" controlled automatic chlorinator or the residual recording unit may be secured separately and used in conjunction with existing chlorinator equipment.

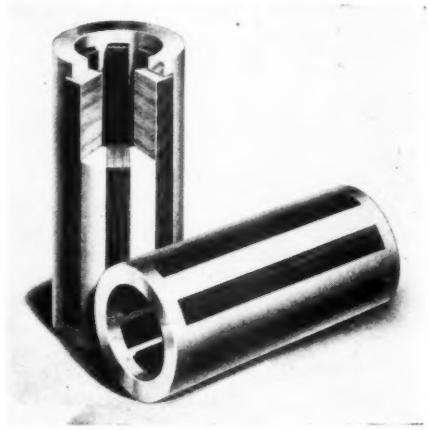
Pacific Pump Produces Bearing

The Pacific Pump Works has recently contributed a most important new device in the line of a self-lubricated bearing for deep well turbine centrifugal pumps. The accompanying picture shows their Pacific "Edgewood" line shaft bearing on which they have been granted a patent and which they have been using for the last couple of years in their deep well turbine centrifugal pumps.

There are many instances where an oil lubricated deep well pump is objectionable due to the fact that oil gets into the water and contaminates same.

After considerable research and experiment, they brought out this "Edgewood" bearing which requires no lubrication whatever after the pump has been installed.

This new bearing consists of a series of wooden wedges held in a die cast metal cage, the wood having first been completely impregnated with a special treatment of lubricants and wax which preserves and lubricates the wood indefinitely. The wedges are mounted so that the end grain of the wood comes against the shaft, thus eliminating any possibility of trouble due to swelling and as one-third of the weight of the treated wood is made up of the lubricants and wax this provides a bearing of exceedingly low friction co-efficient, and does away entirely with the necessity for any further lubrication after the pump has been put in service, consequently insuring a pure water supply.



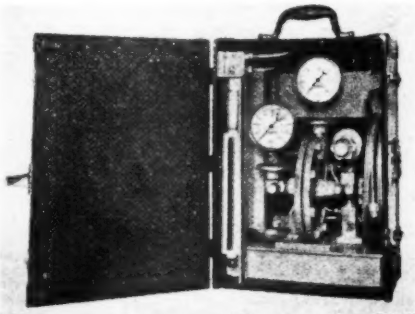
Pacific "Edgewood" Line Shaft Bearing

A New Portable Ammoniator

The Paradon Mfg. Co., of Arlington, N. J., developed a portable ammoniator. The apparatus consists of a standard Paradon Type ADB ammoniator, housed in a fiber carrying case and resembling a piece of hand luggage. The portable ammoniator is adapted to continuous regular use as well as emergency use, as it is designed to do anything that any ammonia-control apparatus will do.

In design, it is essentially like the familiar type of Paradon chlorinator except that the parts are made of material that will withstand the corrosive effects of ammonia. A shut-off valve is provided to keep moisture and foreign material out of the apparatus during periods of non-use. No water supply is necessary for its operation, the ammonia gas being applied directly.

The apparatus can be supplied for any



Paradon Portable Ammoniator

range of capacity from 1 to 300 lb. of ammonia per 24 hours. Equipment can also be supplied that would decrease the minimum capacity to 0.05 lb. of ammonia per 24 hours.

The use of ammonia in connection with chlorination of water supplies is spreading rapidly. Many of the applications of ammonia are temporary and seasonal. It was for taking care of this type of ammonia application that the Paradon type ammoniator was developed.

The Cranemobile

A new convertible machine—the "Cranemobile"—was added to the line of the Bay City Shovels, Inc., Bay City, Mich.

The Cranemobile is an adaptation of the Bay City crawler mounted tractor model. No change is made in the machinery, superstructure or booms and

Bay City Cranemobile

buckets. In place of crawlers heavy steel wheels with large solid rubber tires are substituted permitting faster travel speeds and eliminating crawler wear for long or fast moves. A special heavy duty forged Timken front axle is provided with roller bearings. Steering mechanism is provided under tractor end of machine. The Cranemobile is intended for any material handling job where a truck crane would normally be used or where a fast moving and operating machine is desired for work on hard or relatively smooth ground.

The tractor shovel is to be continued in production, as the Cranemobile is intended for another field of work, where hard surfaces conditions favor a rubber wheel mounted machine, rather than crawlers.

This machine is convertible and, in addition to standard crane attachments, such as clamshell, hook and block, electric magnet, etc., it is available with shovel dipper, trench hoe or skimmer bucket.

Three speeds forward up to seven miles an hour and one speed reverse are available.

30 in. Insertion and 24 in. Connection to 30 in. Main Under Pressure

Although, for more than a quarter of a century, branch connections have been made under pressure and valves have been inserted in straight lines of pipe, using machines manufactured by The A. P. Smith Manufacturing Co., of East Orange, N. J., still it has only been recently that large insertions have been made in this manner.

Recently, at Ogdensburg, N. Y., a 30 in. horizontal valve was inserted and, within a short distance of it, a 24 in. connection for a branch was made to the same 30 in. main, Smith Apparatus being used in both operations.

At no time during the making of the insertion or of the branch connection was the pressure on the main lessened one iota; and, although the work, particularly of making the insertion, required a considerable time to complete, still no one in the city was aware that these important waterworks changes were being made.

The Smith organization is now equipped to make valve insertions from 4 in. to 30 in. inclusively and branch connections up to and including 42 in., the latter with the use of its tapping machine and sleeves.

For making the large insertions—from 16 in. to 30 in. inclusively—and also for making the larger branch connections, the company rents machines for doing the work and along with each of these goes an expert to carefully supervise each operation.

Cut-In Sewer Connection

A device for connecting a house service with a main sewer pipe without the necessity of placing a Y-branch or T-branch in the line has been placed on the market by The Atlas Mineral Products Co., Mertztown, Pa.

The device is a light cast iron fitting with ball and spigot ends and is made for use with both terra cotta and concrete pipe sewers of all sizes, and for house services of either terra cotta or cast iron pipe of the various diameters usually required.

In making use of the cut-in connection a hole of the proper size is cut in the sewer pipe at the required vertical angle, the spigot end of the fitting inserted, a small amount of jute packed in the space between the spigot of the fitting and the rim of the hole in the sewer pipe, and then the cut-in fitting is held rigidly in place by surrounding the outside of the fitting, as far as the base of the bell, and the sewer pipe itself for a short distance on each side of the fitting, with lean concrete or cement mortar applied with a trowel. There is a bead on the spigot end of the cut-in fitting which prevents the jute or concrete from entering the sewer pipe, and the stops or wings on the side of the fitting allow the spigot end to enter the sewer pipe only so far as to be flush with the inner surface of the sewer and thus provide no obstruction to the flow of sewage. The spigot end of the cut-in fittings of the several sizes and types are so shaped as to fit neatly the inside surface of sewer pipes of the various diameters.

Klinck Test and Puddle Plug

Harry W. Klinck of Logansport, Ind., formerly superintendent of the Logansport Water Works has procured a patent on a test and puddle plug for use in backfilling the trench where new water mains are laid.

It is customary when laying water mains, to test the joints under pressure before placing the dirt back in the trench. Then after the joints are found to be tight the trench is filled in. If the soil is not tamped in layers as the trench is filled a mound several feet high is usually left over the pipe. Tamping, however, is very expensive and slows up the work considerably.

The test and puddle plug serves two purposes. It is inserted in the end of the pipe and tightened in place. This plugs the pipe and allows the water pressure to be applied for testing the joints. Dirt is then dumped into the trench a few feet behind the end of the pipe to form a dam across the trench. A short piece of 2 in. pipe or hose is coupled into the test puddle plug and water from the main is allowed to fill the trench behind the earthen dam and the soil is dumped into the trench. No tamping is necessary as the soil packs as it is dumped in trench. While the trench is being filled the test and puddle plug may be removed to allow the laying of additional main. By this method the trench may be backfilled as the work progresses and thus eliminate the danger caused from open ditches.

In a comparative test on laying 300 ft. of 6 in. pipe the savings are stated to have amounted to more than the cost of the test and puddle plug.

The Klinck Test and Puddle Plug is being manufactured and marketed by the H. W. Clark Co., Mattoon, Ill.

Announcing Parsons Model 23 Backfiller

The new Parsons Model 23 backfiller, a high speed machine, is built to power shovel standards and is fully in line with Koehring heavy duty construction as expressed in Koehring shovels, the Koehring paver and the Dumptor.

The main frame consists of a single steel casting on which the entire upper mechanism, including the motor, is mounted. This casting is recessed to form housings for the traction bevel

New Parsons Backfiller

gears and the main drive spur gears. These gears in addition to the entire train of gears from the motor are entirely enclosed and operate in a bath of oil. The frame supporting the upper or hoist drum and the A frame supporting the boom are also steel castings. With the exception of the multiplanes, all moving parts are on, and accessible from, the upper side of the main cast frame.

Power is applied independently to the traction and the hoist and drag drums so that each may be operated separately

or simultaneously. This is one of the reasons for the higher backfilling speed of the Model 23, as compared to other backfillers of similar size, as the machine can be moved on traction in either direction while using either the draw or hoist drum.

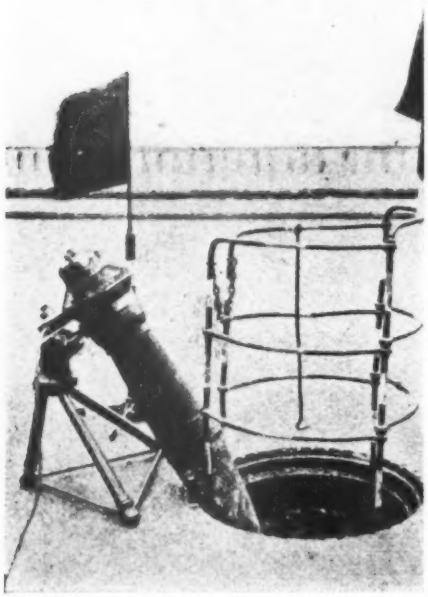
The multiplanes are of Koehring design with self-cleaning idler and drive tumblers and the tread plates are the same as the Koehring design excepting that they are cast in one piece without the welded shoe plate.

Rapid Method of Expelling Sewer Gas

A quick and efficient method of overcoming the hazards of manhole work by expelling accumulation of carbon monoxide gas which has been employed by the street department of the City of New York is found in the Coppus Vano blower shown in the illustration.

This is a light weight blower, and it is stated that by its use a job that formerly required one-half hour or more to expel the gas is now accomplished in approximately five minutes' time.

The equipment itself is a propeller type blower of unique design and construction. One of the outstanding features is the application of stationary guide vanes of peculiar design beyond the propeller. The air current leaving the propeller is radially subdivided by the individual guide vane blades and taken up by them without shock. The guide vane blades, which have a curvature increasing in the direction of rotation of the propeller, concentrate the air current and give it a further acceleration inside of the stationary guide vanes so that a considerable part of the pressure is produced in the latter. A large part of the end thrust is thus taken up by the stationary guide vane casing. The air streams, into which the flow of air has been subdivided by the guide vane blades, leave the guide vane casing, on account of the kinetic energy, slightly rotating and convergent toward the axis so that the smallest section of the air flow is reached beyond the guide vane casing. This in actual operation is stated to make the Vano blower extremely efficient for use with hose extension as employed in sewer work.



Blower for Expelling Sewer Gas

Another advantage found in the employment of this equipment is its light weight and portability; weighing less than 100 lb., it can be quickly set up and placed in operation by one man. Attachment for the electric current is made at any convenient outlet.

The blower is a product of the Coppus Engineering Corporation, Worcester, Mass.

Warren-Knight Develops Transit-Level

The new Warren-Knight transit-level is an instrument of entirely new design, with new optical system and new dual bearing standards, a new and exclusive feature which enables the adjustments of the telescope and level to be checked as easily and in the same way as an ordinary wye level. It is an accurate, dependable, compact instrument, conveniently packed in a substantial hardwood, carrying case, complete with trivet pins, plumb bob, reading glass, sunshade and tripod.

Warren-Knight's Entirely New Principle Transit-Level

Some of the main features follow:

(1) Although the instrument resembles a transit in design, construction and appearance, it can be adjusted in the same manner and as easily and quickly as a wye level.

(2) It has a maximum tilt of 110 deg.; 55 deg. above and 55 deg. below the horizontal.

(3) The horizontal or graduated circle has a vernier reading to single minutes.

(4) The horizontal circle is fully protected by a heavily ribbed top plate.

(5) The telescope with level attached is provided with clamp and tangent for quickly and accurately taking level readings.

(6) The telescope has a magnifying power of 22 diameters and a special lens combination which enables a sharp sight as close as 4 ft. from the center of the instrument.

(7) The instrument has a full ¾-in. shift on the tripod plate.

(8) The tripod plate and tripod are furnished with U. S. standard thread, as recommended by U. S. Bureau of Standards.

(9) The tripod plate is equipped with three detachable pins, enabling the plate to be used as a trivet.

(10) Cylindrical telescope axle; stronger, holds adjustments better, costs less to repair.

(11) 120 deg. vertical arc with clamp and tangent; makes it easy to run levels or measure vertical angles.

(12) 3-in. compass with jewelled needle (on models No. 38-a and -b); increases scope of usefulness for use of instrument in surveying work.

(13) Non-cramping level head: enables quick set up without strain on leveling head or screws.

(14) Heavily reinforced head, limb and top plate; assures long life with low maintenance costs.

(15) "L" section standards with heavy footings; insure stability and permanence of adjustments.

(16) The tripod plate is equipped with three detachable pins; plate can be used as a trivet, for use on walls, window sills, etc.

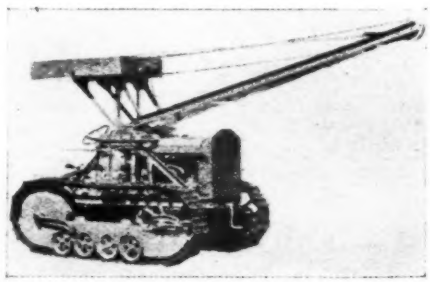
Copies of their new catalog are available for any interested readers without obligation or expense.

New Tractor Crane Unit

The Hughes-Keenan Roustabout crane, which is manufactured by the Hughes-Keenan Co., Mansfield, O., has been adapted to the Model GU Trackson Allis-Chalmers Industrial crawler tractor. This combination provides a compact, flexible, and easily operated crane unit.

Both the crawler unit and the crane are sturdily constructed and designed for heavy duty. The Model GU Trackson Crawler was built to meet the needs of industrial users, and is especially suited to the operation of auxiliary equipment like the Hughes-Keenan Roustabout crane. This crawler has the open design and wide clearances which are necessary for the inbuilding of such attachments.

The boom of the Hughes-Keenan crane is full-revolving, swinging in all directions through a complete circle, on a ball-bearing turntable, and it is effective at all points because the counterweight box is



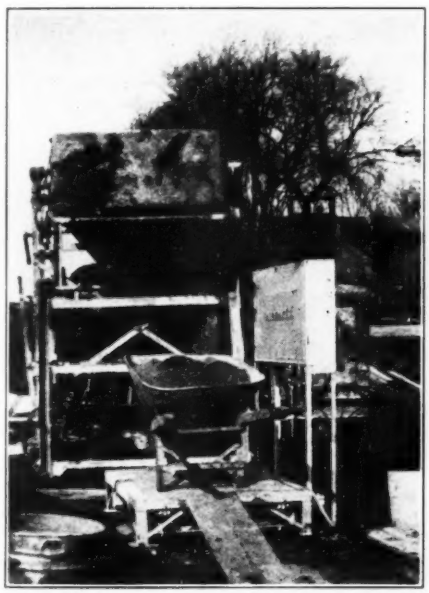
Hughes-Keenan Roustabout Crane

mounted on the turntable. The boom can be raised or lowered by power, and the load can also be lifted or lowered without moving the boom. The load is raised by a cable which is wrapped on a drum and which is independent of the cables that hold the boom in place.

Another important advantage of this equipment is the fact that the crane does not interfere with the use of the crawler tractor for drawbar operations, and therefore the outfit is really an all-purpose power unit.

Fairbanks Announces Wheelbarrow Scale

To meet a growing demand on the part of construction engineers generally for measurement by weight instead of by volume in the mixing of concrete, Fairbanks,



New Fairbanks Wheelbarrow Scale for Concrete Contractors

Morse & Co. has developed a highly accurate, light weight, sturdy scale for weighing wheelbarrow loads of ingredients. All weighing can be done on the one scale, as it is provided with a tare bar and two beams, one for sand and one for stone. In every way it meets specifications prepared by the Associated General Contractors of Washington, D. C., and adopted by the American Road Builders' Association.

This scale provides an accurate scientific control of the mix and enables the contractor to meet rigid specifications without increasing the labor cost of mixing. There are two sizes, one of which has a 42-in. by 30-in. platform for weighing wheelbarrows and weighs complete only 275 lb. The other has a 42-in. by 42-in. platform, especially designed for weighing materials in carts or buggies; it weighs 320 lb. Both are of welded steel construction throughout and are carefully braced for strength.

Three beams are provided, the top one being a tare bar used to balance the weight of the empty wheelbarrows and the two lower, each graduated 500 by 2 lb., are one for sand and the other for stone. A new style springless "over-and-under" tell-tale device, carefully protected from dust and corrosion, is connected with the beams and so mounted that it can be swung to any angle to insure easy reading from any position of the operator.

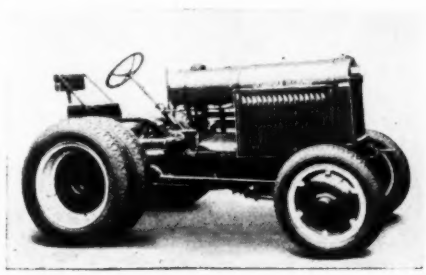
In using the scale the tare bar poise is set to balance the empty wheelbarrow and in locked position. The poise on the sand beam is located at the point representing the desired amount of sand for each wheelbarrow load and this poise is locked in position. The poise on the gravel beam is likewise located at the proper point and locked. Either the sand or the stone beam may be thrown into weighing position independently of the other. In the further interest of accuracy the beam box may be locked after the poises are set so that they cannot be tampered with. The frame of the scale is open on all sides and the platform may be easily lifted off when necessary to facilitate thorough cleaning of the scale parts. Construction is such that it is proof against danger of disarrangement while in transport from place to place.

New McCormick-Deering Industrial Tractor

The McCormick-Deering industrial tractor, Model 30, is the latest addition to the McCormick-Deering industrial power family. It is a large industrial tractor embodying the many desirable construction and performance features of the Model 20.

This new model meets the demand for an industrial tractor capable of operating the new and larger equipment being introduced to industry. It is readily adaptably to mobile equipment. Loads and equipment are safely and comfortably moved at speeds common to the smaller-sized tractors due to the wide rubber-tired wheels. Forward speeds are 2.5, 4 and 6.7 mi. per hr.

The Model 30 industrial tractor is powered by a four-cylinder valve-in-head engine. The cylinders have a bore of 4¾ in. and 6-in. stroke. Operating at the governed speed of 1,050 r.p.m., it develops over 40 hp. on the belt. The tractor can be equipped with a belt pulley, which attaches to the right-hand side of the tractor. The belt pulley is 16¾ in. in diameter with a 9-in. face and travels at 593 r.p.m., providing a belt speed of 2,600 ft. per minute. The belt pulley can



McCormick-Deering Industrial Tractor, Model 30

be replaced by a sprocket or a shaft power take-off. The speed, however, will be the same as the belt pulley: i. e., 593 r.p.m. The power take-off shaft is available on special order for delivering power at the rear of the tractor. It is a 1½-in. shaft with a left-hand thread and travels at 536 r.p.m.

The many distinctive McCormick-Deering features are incorporated in the Model 30 industrial tractor. Outstanding among these are the removable cylinders and the crankshaft ball bearings. All users of gas-engine power appreciate the fact that cylinders will wear after years of use. In order to compensate for this wear, it is necessary to do one of three things: First, replace the engine block; second, rebore the block and buy oversize pistons; or third, replace the cylinders. The third or last of these is far more economical and at the same time retains the original size of the cylinders.

Shepard Develops New Instrument

As a result of the study of corrosion on underground pipes, which the Bureau of Standards has been carrying on for a number of years, a new instrument has been developed for simply and quickly measuring the electrical resistivity of soil

New Shepard Earth Resistivity Meter

in place, without the necessity of removing the samples to the laboratory for examination. The bureau has found that soils high in soluble salts, and therefore low in electrical resistivity, are usually highly corrosive to pipe lines. Such low resistance soils are frequently found as naturally occurring outcrops or pockets in areas of otherwise normal or high resistivity. The predetermination of such areas is a matter of great importance to the pipe line companies as well as to the utility operators, as this knowledge will enable them to provide suitable protection to their pipes in exceptionally corrosive soils.

The present tendency in the protection of pipes against soil corrosion is away from a uniform coating for the entire length of the line and toward the application of coatings selected with respect to the corrosive character of the soils involved. This calls for a knowledge of varying soil conditions and a means of locating local corrosive soil areas. Such areas, commonly termed "hot spots" are prevalent in many types of soil, and it

is in these regions that pipe lines suffer the greatest deterioration.

Although the Bureau of Standards has found no direct relation to exist between the electrical resistivity of soils and their corrosive properties, abrupt changes in resistivity and unusually low resistivity are found to be significant with respect to corrosion. Soils having a resistivity of about 500 ohm-centimeters or less are found to be highly corrosive. A better relation between resistivity and corrosiveness exists in alkali than in acid soils.

The Shepard Earth Resistivity meter shown in the illustration consists of two rods or canes tipped with iron electrodes. A flashlight battery and milliammeter are mounted in a light aluminum frame on one of the rods. The rods are pushed into the earth with a separation of about one foot or more, at the bottom of a pair of auger holes, a shallow excavation, or the side of an open trench. The circuit is then closed and the resistivity of the soil is read directly in ohm-centimeters on the scale of the instrument.

A feature of the apparatus which is unique is the manner in which polarization has been overcome or minimized and by which an accuracy closely approaching a. c. bridge determinations has been attained. This has been accomplished by making the cathode or negative electrode very much larger than the anode or positive electrode, as shown in the accompanying figure. Polarization, which is largely a cathode effect and is also a function of current density, is greatly reduced by employing electrodes differing greatly in areas.

Two scales are provided on the meter, one ranging from 400 ohm-cm. upward and the other from 100 to 500 ohm-cm. Provision is also made for checking the voltage of the three-volt flashlight battery carried in the aluminum hand grip. The device, which was developed by E. R. Shepard of the Bureau of Standards, is being built and distributed by O. S. Peters of 930 H Street, N. W., Washington, D. C. It is already being employed by several large pipe line companies in Texas, Louisiana, and California in connection with their reconditioning programs.

New Continuously Cleanable Strainer

The Cuno Auto-Klean Strainer is of sturdy all metal disc construction, entirely and positively cleanable, without disassembly, by rotation of a central projecting spindle, yet is obtainable with spacing equivalent to the finest mesh.

The strainer unit is composed of alternate perforated discs and spacers keyed to a central spindle, the thickness of the spacers determining the fineness of the straining. The compressed cylindrical stack of discs and spacers is closed at one end and open at the other to the outlet passage.

The straining action takes place as the liquid passes, under suction or pressure, across the edges of the discs from the exterior to the interior of the stack, or cartridge, through the passages maintained by the spacers.

Cuno Auto-Klean Strainer

All suspended matter of a size larger than the thickness of the spacers, and through filter bed action, much of smaller size, is deposited on the exterior of the cartridge.

Adjacent to the cartridge is a fixed rod to which is assembled a series of cleaner blades, one of which extends into the space between each pair of discs as far as the inner edge of the rim. As the central spindle carrying the discs is rotated these cleaner blades gather up the matter which has been deposited on the cartridge and comb out anything which may have got between the discs, leaving the strainer as clean as when first put in service. The compacted sludge sinks to the sump space from which it may be removed at infrequent intervals. Where continuous operation is required a sump shut-off can be provided so that the sump may be cleaned while the filter is in operation.

On water jobs where a small stream may be run to waste a sump drain is sometimes provided to run off the sludge as rapidly as it accumulates.

Many of these strainers are in successful operation in industrial plants where large quantities of river water are used for cooling and other purposes, on city water lines where for photographic use, or in connection with humidifying apparatus, it is important that all suspended matter be removed to as complete an extent as is possible, with a minimum of attention to the strainer. A motor drive is provided for continuous rotation of the spindle if required.

Units of all sizes and capacities are manufactured and may be obtained in materials suited to any condition of service. They are furnished complete with sumps of various sizes and for low or high pressure service, or without sump use in connection with other apparatus.

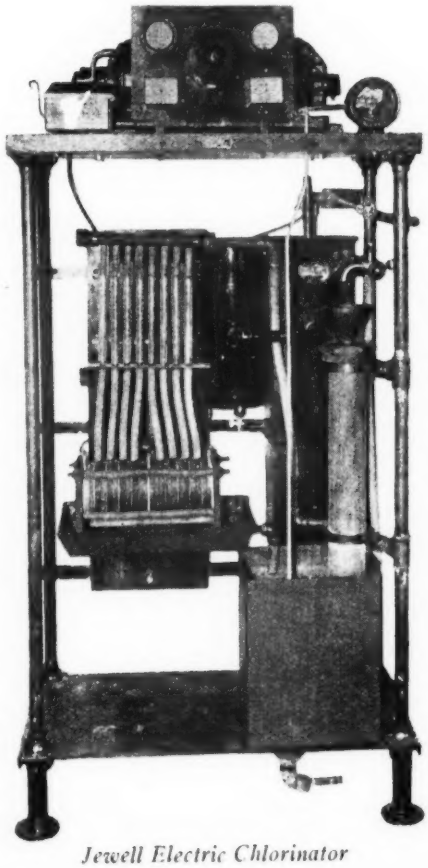
These strainers are manufactured under Auto-Klean license by the Cuno Engineering Corporation, South Vine St., Meriden, Conn.

Everson Manufactures Jewell Chlorinator

Everson Filter Co., Chicago, Ill., announce the Jewell Electric Sterilizer, which is their newest and most outstanding development in water sterilization.

This device can be used for purifying the water in swimming pools or maintaining sterility in drinking water.

The unique distinction of the Jewell Electric Sterilizer is that it produces pure neutral sodium hypochlorite and, when injected either in drinking water and swimming water, has neither odor nor point of irritation. This is a material improvement over the use of chlorine when used in excess, inasmuch as chlorine does carry a considerable odor and distinct irritation arises if the quantity used is not most carefully guarded.



Jewell Electric Chlorinator

Armco Develops Boring Machine

Soft spots in the roadbed of highways and railroads have long been a source of trouble and expense to maintenance men. Increasingly heavier rolling equipment and high speeds have aggravated such conditions and have intensified the need for a quick, economical method of installing drainage—now recognized as the cure of the majority of such conditions—which would not interfere with the use of the traveled surface. This need has been met by the development by the Armco Culvert Mfrs. Association, during the past four years, of a boring machine, designed for the express purpose of installing corrugated iron drain pipe in 8, 12, and 18-inch diameters.

The Armco boring machine serves the double function of excavating and removing the material replaced by the pipe, and jacking the pipe into place. The entire machine is mounted on a track upon which it moves forward as jacking progresses. The jacking itself is done by hand at the rear of the machine by means of an especially designed jack operating on a rack between the tracks. Power for excavating is provided by a gasoline motor and is transmitted to the "borer" by a shaft extending through the pipe. A spiral conveyor is built around this shaft, which, as it revolves, removes the spoil through the pipe upon a smooth metal trough placed in the invert. When a section of pipe has been placed, the machine is returned to the starting point, another section of pipe and a corresponding length of lining and conveyor attached, and the process repeated. This is continued until the required amount of pipe is placed.

The installation of drainage by the Armco boring machine has many advantages over the former open trench practice. It eliminates a long construction period with its attendant detours, slow orders, and interrupted schedules. Substantial savings, depending on the depths of the installations, have been secured where this machine has already been used. Traffic is not interfered with while construction is in progress, neither is there an unstable roadbed or a marred pavement to be maintained after the job has been completed. Since only a comparatively small surface area is affected, pipe can readily be installed in this manner during the winter months.

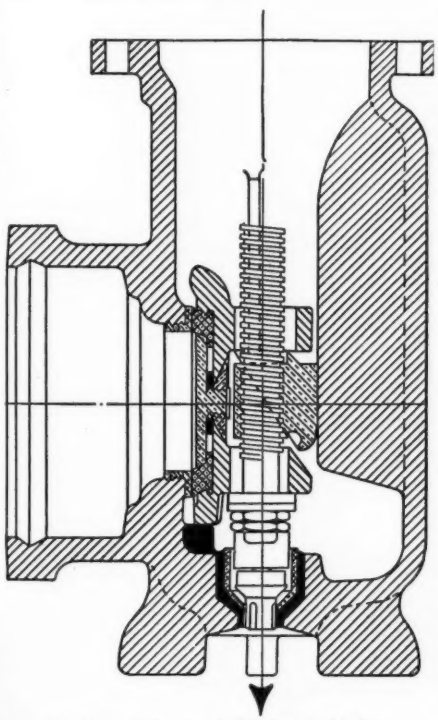
Although subdrainage installations probably present the greatest opportunity in the use of this machine, it is also applicable for installing conduits for gas, water, telephone, and electric light lines, small drainage openings, or any other purpose for which small diameter pipe is satisfactory.

Armco Boring Machine in Action

Ludlow Introduces New Hydrant

The Ludlow Slide Gate hydrant valve has certain distinct advantages:

1. No water hammer because the gate in closing is operating against the flow and is evenly seated by the wedging action of the bronze nut.



Ludlow Diamond Hydrant Valve

2. When the valve is fully open the gate is raised against the wall, so that the gate seat is less exposed to the abrasive action of foreign matter in the water.

3. Easily renewed with no digging. The entire mechanism can be withdrawn without disturbing the bronze seat ring.

4. The drip is at the extreme bottom of the hydrant bottom, and allows the hydrant to drain completely, leaving no water standing to freeze.

The new hydrant bottom represents a distinct improvement over former models. The back guide is now made parallel with the seat, and the gate stop is placed immediately beneath the gate under the seat. This insures the smooth, firm seating of the gate and removes all strain from the valve stem.

The lines of force are opposed inward and directed downward. Once tightly closed with the drip valve open, the gate mechanism is locked and cannot be released except by turning the valve stem.

Thus the bottom will not flood if the hydrant body is broken, since it is a self-contained unit: there is no pressure against the packing plate at the top of the hydrant. The Ludlow Diamond Hydrant body may be replaced at the ground line if broken by any cause. The water need not be turned off because the valve will remain closed.

Like the polished diamond the Ludlow Diamond is self-illuminating, for its eight flat surfaces reflect the light from all directions.

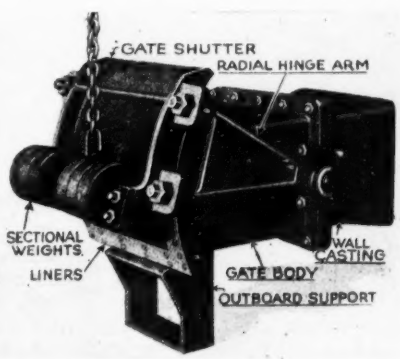
Automatic Sewage Regulators

Brown and Brown, Inc., of Lima, O., announce the development of automatic sewage regulators shown in the accompanying figure. Each is composed of three units as follows:

1. Gate Assembly.
2. Float Assembly.
3. Transmission Assembly.

The regular gate is of the reverse tainter type and mainly comprises wall casting, gate body and gate shutter. The wall casting is of cast iron with tube belled out to approximate the "vena contracta" of the inflowing stream. To the wall casting is attached the gate body which is provided with trunnions about which the gate shutter turns and to which it is connected by bronze radial hinges. All parts are accurately machined. Gate bodies and shutters are regularly faced with non-corrosive metal. The gate body is provided with an outboard support which also serves as a stop to limit the downward travel of the gate shutter. The lifting chain is attached to the gate shutter at its exact center of gravity. On account of it being impossible to predetermine the exact location of the center of gravity sectional weights are provided as a means of shifting the center of gravity to the preferred point during final test and prior to shipment. Attachment of the lifting chain at this point causes a fixed tension in the lifting chain regardless of the position of the gate shutter within its working limits.

Lubrication is provided for by the ap-



Brown and Brown Sewage Regulator

plication of Alemite fittings to the shaft bearings and gate trunnions. Ample lubricant reservoirs are provided so that several months may elapse between applications.

Automatic sewage regulating equipment is furnished complete with anchor bolts, anchor bolt setting plans and complete instructions for erecting.

American-Moninger Develops Sludge Bed Enclosures

The American-Moninger Greenhouse Manufacturing Corporation of Brooklyn, New York, has just been engaged to build and erect the large glass enclosure over the sludge beds of the new sewage treatment plant for the City of Lima, O. The area covered is approximately one acre.

H. P. Jones & Company of Toledo, O., were the successful engineers on this job. This company let the contract for the construction of this plant to Green & Sawyer, of Lima, O.

Among recent completed jobs is the American-Moninger Glass Sludge Bed Enclosures for the sewage disposal plant of the City of Dunkirk, New York. Two of these were constructed and erected at this plant—one was 74 ft. x 125 ft. and the

American-Moninger Sludge Bed Enclosures

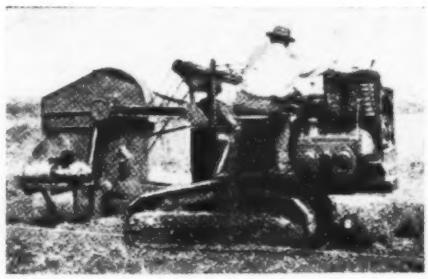
other 74 ft. x 250 ft. These enclosures differ from ordinary glass enclosures in that the frame work was built strong enough to support the overhead trolleys used for handling the Louden buckets.

Some of the other glass enclosures built by the American-Moninger Greenhouse Manufacturing Corporation are namely: The installation at the sewage disposal plant of the City of Marceline, Mo., the enclosures for the Calumet Sewage Disposal Plant of the Sanitary District of Chicago, Ill., and the enclosures for the sewage disposal plant of the Borough of Blawnox, Pa.

New Small Ditcher

A vertical boom ditcher that is only 4 ft. wide and 11 ft. 6 in. long, and when digging is no higher than a tall man's head was added to the line of the Barber-Greene Co. of Aurora, Ill.

The new machine—the Service Special Ditcher—has all of the features of the big Barber-Greenes. It is crawler mounted. It has the vertical boom which allows it to dig right up to a sidewalk or curb, ending the trench flush, and to cut a square corner. As an insurance against strains caused by striking underground obstacles and as a protection to any underground pipes, the machine is equipped with the standard B-G overload release sprocket, a device that automatically stops the bucket line without injuring anything or killing the engine. The construction of this sprocket is such that at every half revolution, it exerts a pull on the bucket



The Service Special Ditcher

line before slipping again, and if the operator desires, he can keep the buckets pounding at the obstacle until it is cut through.

The buckets clean themselves automatically, even in very sticky material. Attached to the boom is a telescoping follow-up scraper for insuring a clean trench. The boom is raised by power, making it possible for the operator to dig accurately to grade at all times.

The traveling speeds of the Service Special are 2 miles and 1 1/3 miles per hour. Its speed, small size, and crawler mounting make it highly maneuverable. The ditcher is built throughout of heavy structural steel and is powered by a 33 B.H.P. four cylinder Buda gasoline engine.

Gibson's Improved Cutter

A. C. Gibson Co., Inc., Buffalo, N. Y., state that Gibson's receipting coupon cutter is a time saver and with the use of one of these machines a cashier is enabled to handle a much larger number of customers than would be possible by any other method in the same period of time. When the bill is presented for payment the cashier places same in position on the machine, and pulls the lever forward. Upon release of the lever it will immediately return to its former position, with the printing dies resting upon the inking pad, ready for use on the next bill. In this one operation the bill has been receipted, the coupon marked "Paid," cut from the body of the bill and automatically deposited in the locked drawer. A complete record of the transaction for future reference.

A metal guard is placed over the opening through which the coupons drop into the drawer, in such a manner that it is practically impossible to remove any of these coupons. Each machine is adjusted for the particular bill form to be used with it and a permanent gauge pin set for the width of the coupon to be clipped, thus enabling the operator to work very rapidly.

The cabinet work on Gibson's receipting coupon cutter boxes is done in oak, well finished, and has polished brass trimmings. They are built low and wide, to prevent tilting while being operated.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of Water Works and Sewerage, published monthly at Milwaukee, Wisconsin, for April 1, 1931.

State of Illinois } ss.
County of Cook }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared E. S. Gillette, who, having been duly sworn according to law, deposes and says that he is the business manager of Water Works and Sewerage and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—Gillette Publishing Company, 221 East 20th Street, Chicago, Ill. Editor—H. P. Gillette, 221 East 20th Street, Chicago, Ill. Managing Editor—C. T. Murray, 221 East 20th Street, Chicago, Ill. Business Manager—E. S. Gillette, 221 East 20th Street, Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

Gillette Publishing Company, 221 East 20th St., Chicago, Ill.; H. P. Gillette, 221 East 20th St., Chicago, Ill.; E. S. Gillette, 221 East 20th St., Chicago, Ill.; Mrs. R. W Hume, 303 S. Stone Ave, LaGrange, Ill.; Winifred Gillette, 1125 Oak Grove Ave., San Marino, Calif.; Commonwealth Title Insurance & Trust Co., Chestnut & 12th Sts., Philadelphia, Pa.; Louise Forsythe, 13 E. Winderemere Terrace, Lansdowne, Pa.; LaVerne Louer Hellyer, Ambassador Hotel, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is (This information is required from daily publications only.)

E. S. GILLETTE.
(Signature of business manager.)

Sworn to and subscribed before me this 27th day of March, 1931.

KITTIE C. WOULFE,
(SEAL) Notary Public.
(My commission expires Feb. 8th, 1934.)

Who's Who

Among Manufacturers, Their Representatives and Distributors in the Field of Water Works and Sewerage

R. C. BEAM
Manager Spiral Welded Pipe Dept.
American Rolling Mill Co.
Middletown, Ohio

A. W. BRYANT
Engineer Detroit District
American Rolling Mill Co.
Middletown, Ohio

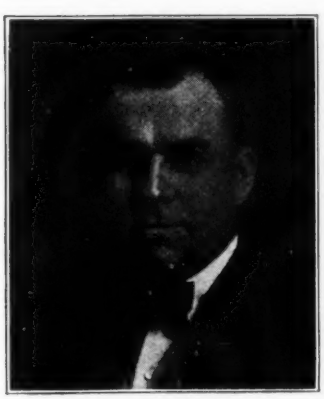
W. W. GRAHAM
Engineer Cincinnati District
American Rolling Mill Co.
Middletown, Ohio

H. M. IVES
Sales Engineer
American Rolling Mill Co.
Middletown, Ohio

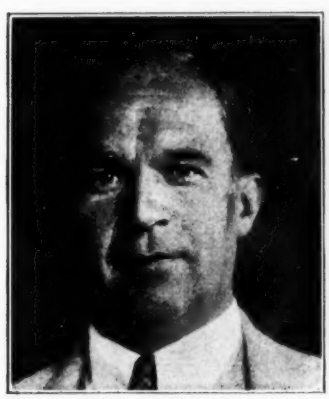
J. S. THOMAS
Sales Engineer
American Rolling Mill Co.
Middletown, Ohio

R. E. WALKER
Kansas City Office
American Rolling Mill Co.
Middletown, Ohio

J. S. WILSON
Engineer San Francisco Office
American Rolling Mill Co.
Middletown, Ohio



M. G. VOIGHT
Manager Machinery Sales
Alamo Iron Works
San Antonio, Texas



H. S. JOHNSON
V. P. in Charge of Sales
American Hoist & Derrick Co.
St. Paul, Minn.

H. G. CHAPMAN
President
The American Well Works
Aurora, Ill.

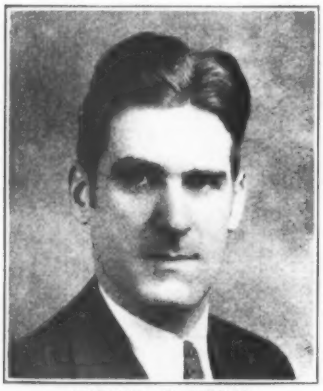
R. D. MAHAFFEY
Vice-Pres. and Treas.
The American Well Works
Aurora, Ill.

H. W. SPILLER
Secretary
The American Well Works
Aurora, Ill.

R. B. CHAPMAN
Asst. Secy. and Asst. Treas.
American Well Works
Aurora, Ill.

R. W. RUTH
Sales Manager
The American Well Works
Aurora, Ill.

M. F. WIRTZ
President
The Atlas Mineral Prod. Co. of Pa.
Mertztown, Pa.

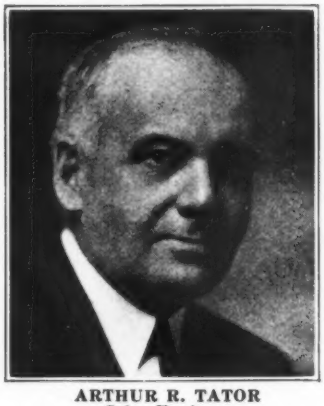


ARTHUR F. WIRTZ
Treasurer
The Atlas Mineral Prod. Co. of Pa.
Mertztown, Pa.

GEORGE L. WIRTZ
Secretary
The Atlas Mineral Prod. Co. of Pa.
Mertztown, Pa.

E. A. KINGSLEY
Sales Engineer
The Atlas Mineral Prod. Co. of Pa.
Mertztown, Pa.

BEN H. BLACK
Western Sales Director
The Atlas Mineral Prod. Co. of Pa.
Mertztown, Pa.



ARTHUR R. TATOR
Sales Engineer
The Atlas Mineral Prod. Co. of Pa.
Mertztown, Pa.

C. W. HENDRICKSON
Sales Engineer
The Atlas Mineral Prod. Co. of Pa.
Mertztown, Pa.

J. W. WILLIAMS
Pacific Coast Manager
The Atlas Mineral Prod. Co. of Pa.
Mertztown, Pa.

O. A. SEYFERTH
President
Austin Machinery Co.
Muskegon, Mich.

JOHN J. McCABE
Eastern Dist. Rep. (New York)
Automatic Cone Valve Co.
Chicago

FREDERICK H. BRADFORD
President
Automatic Primer Company
Chicago

OLIVER B. AVERY
President
O. B. Avery Company
St. Louis, Mo.

T. C. HERSEY
Sales Engineer
E. W. Bacharach & Co.
Kansas City, Mo.

A. W. LIVINGSTON
Sales Engineer
E. W. Bacharach & Company
Kansas City, Mo.

ERIC W. BACHARACH
President
E. W. Bacharach & Company
Kansas City, Mo.

EDWARD R. BACON
President
Edward R. Bacon Company
San Francisco, Calif.

B. E. LINDSTROM
Chicago Dist. Mgr. of Sales
Barber-Greene Company
Chicago

MORGAN RAMSAY
Vice-president
Bay City Shovels, Inc.
Bay City, Mich.

ARTHUR W. BLAKE
President and Manager
W. L. Blake & Company
Portland, Maine

C. W. WRIGHT
President
Badger Meter Manufacturing Co.
Milwaukee, Wis.

LUKE L. BALLARD
Vice-Pres. and Genl. Sales Mgr.
Badger Meter Manufacturing Co.
Milwaukee, Wis.

H. BUCHHOLZ
Secretary-Treasurer
Badger Meter Manufacturing Co.
Milwaukee, Wis.

E. M. KRUEGER
Chief Engineer
Badger Meter Manufacturing Co.
Milwaukee, Wis.

J. C. MILLER
Research Engineer
Badger Meter Manufacturing Co.
Milwaukee, Wis.

WILLIAM T. BIRCH
President
Birch Manufacturing Co.
Chicago

THOMAS F. WOLFE
Research Engineer
Cast Iron Pipe Association
Chicago

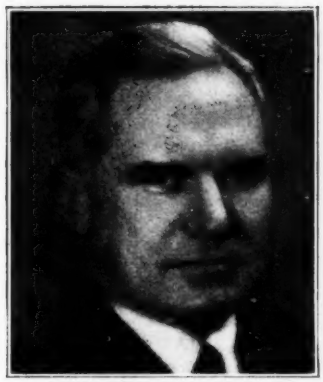
CHAS. K. BASSETT
Vice-Pres. and Secretary
Buffalo Meter Company
Buffalo, N. Y.

JAMES ASTON
Consulting Metallurgist
A. M. Byers Company
Pittsburgh, Pa.

CATERPILLAR ENGINEERING STAFF
Left to right: R. H. Gardner, Walter Harn, C. A. Spears, Ralph Morgan, Frank A. Nikirk

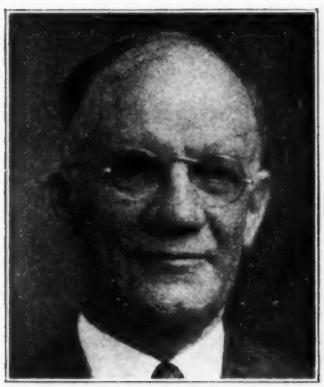
JOHN V. SCHAEFER
President
Cement Gun Construction Co.
Chicago

GEO. T. HORTON
President
Chicago Bridge & Iron Works
Chicago



MERLE J. TREES
Vice-President
Chicago Bridge & Iron Works
Chicago

CARL H. SCHEMAN
Gen. Mgr. Horton Steel Works, Ltd.
Chicago Bridge & Iron Works
Chicago



C. M. LADD
Contracting Engineer
Chicago Bridge & Iron Works
Chicago

C. R. MESSINGER
Chairman of Board
Chain Belt Company
Milwaukee, Wis.

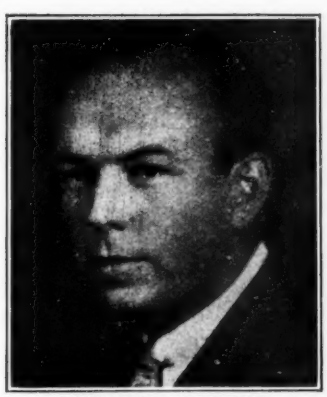
DONALD M. CLARK
President
H. W. Clark Company
Mattoon, Ill.

K. W. CLARK
Secretary-Treasurer
H. W. Clark Company
Mattoon, Ill.

H. POMEROY CLARK
Factory Representative
H. W. Clark Company
Mattoon, Ill.

EDWARD S. DEAN
Eastern Representative
H. W. Clark Company
Mattoon, Ill.

ALLAN J. COLEMAN
President
Allan J. Coleman
Chicago



REEVES J. NEWSOM
Executive Vice-President
Community Water Service
New York, N. Y.

C. D. FLEMING
Vice-President
The Cleveland Tractor Co.
Cleveland, Ohio

H. E. ORR
Advertising Manager
The Cleveland Tractor Co.
Cleveland, Ohio

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Copper & Brass Research Assn.
New York, N. Y.

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President
Continental Motors Corp.
Detroit, Mich.

L. J. KANITZ
Genl. Sales Manager
Continental Motors Corp.
Detroit, Mich.

I. I. SOLZMAN
Manager
Corken Pump & Machinery Co.
Tulsa, Okla.

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President
Darling Brothers, Ltd.
Montreal

F. W. DuBOIS
Vice-President
Dally & DuBois, Inc.
Detroit, Mich.

J. D. EVANS
President
Evans Tractor & Equipment Co.
Rapid City, So. Dak.

A. F. BARRON
Chicago District Manager
Dayton-Dowd Co. and Simplex
Valve & Meter Co.

M. B. MacNEILLE
Western Sales Manager
Dayton-Dowd Company
San Francisco, Calif.

F. W. GARTNER
President
F. W. Gartner Company
Houston, Texas

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President
Cutler-Hammer, Inc.
Milwaukee, Wis.

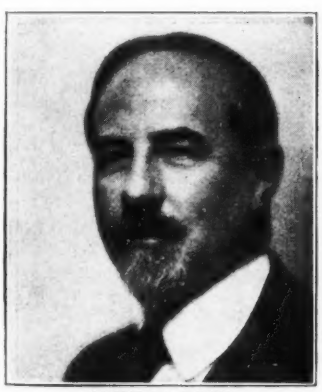
J. C. Wilson
Vice-President
Cutler-Hammer, Inc.
Milwaukee, Wis.

H. F. VOGT
Treasurer
Cutler-Hammer, Inc.
Milwaukee, Wis.

W. C. STEVENS
Secretary
Cutler-Hammer, Inc.
Milwaukee, Wis.

E. A. BACON
Director
Cutler-Hammer, Inc.
Milwaukee, Wis.

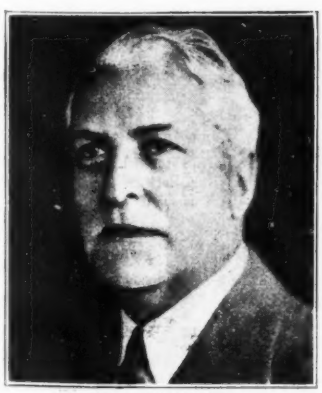
G. S. CRANE
General Sales Manager
Cutler-Hammer, Inc.
Milwaukee, Wis.



JOHN V. DORR
President
The Dorr Company
New York, N. Y.

FRANK BACHMANN
Mgr. Sanitary Engr. Dept.
The Dorr Company
New York, N. Y.

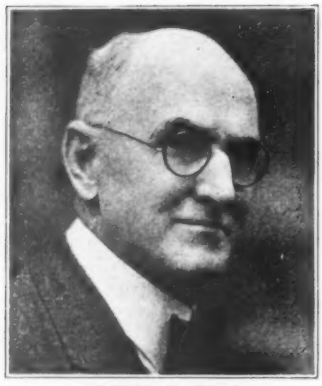
J. A. MANLEY
Vice-President in Charge of Sales
Fairbanks, Morse Company
Chicago



F. A. MILLER
Chairman of Board
S. R. Dresser Mfg. Company
Bradford, Pa.

H. N. MALLON
Pres. and Genl. Mgr.
S. R. Dresser Mfg. Company
Bradford, Pa.

G. H. PFEFFERLE
Chief Engineer
S. R. Dresser Mfg. Company
Bradford, Pa.



EDWIN H. FORD
President
Ford Meter Box Company
Wabash, Ind.

T. W. McNAMEE
Secretary-Treasurer
Ford Meter Box Company
Wabash, Ind.

JOHN L. FORD
Sales Manager
Ford Meter Box Company
Wabash, Ind.

RICHARD V. FORD
Eastern Representative
Ford Meter Box Company
Wabash, Ind.

WILBUR E. FORD
Factory Manager
Ford Meter Box Company
Wabash, Ind.

W. A. OLEN
President
Four Wheel Drive Auto Company
Clintonville, Wis.

R. H. SCHMIDT
General Sales Manager
Four Wheel Drive Auto Co.
Clintonville, Wis.

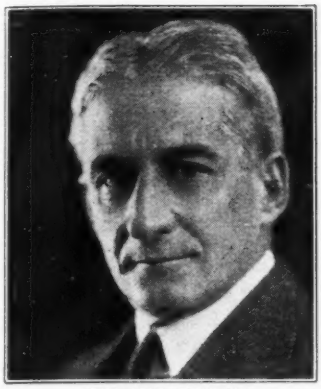
A. F. GARLINGHOUSE
Garlinghouse Brothers
Los Angeles, Calif.

L. H. GARLINGHOUSE
Garlinghouse Brothers
Los Angeles, Calif.

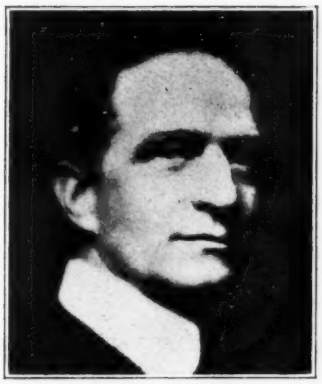
M. C. GRIFFIN
"Griff the Pump Man"
Toledo, Ohio

W. L. VANSANT
Goldsboro & Vansant, Inc., Pittsburgh, Dist. Rep. Dayton-Dowd Co., Quincy, Ill.; Sterling Pump Corp., South Bend, Ind.; Simplex Valve & Meter Co., Philadelphia; Lakeside Engr. Corp., Chicago

J. M. BEATTY
Mgr. Water Works Sales Dept.
The Hardware & Supply Co.
Akron, Ohio

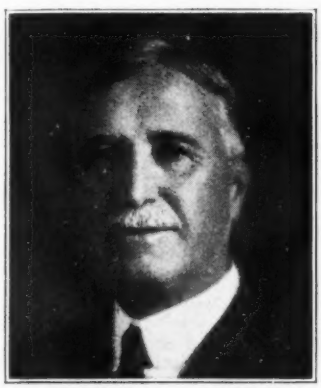


GERARD SWOPE
President
General Electric Co.
Schenectady, N. Y.



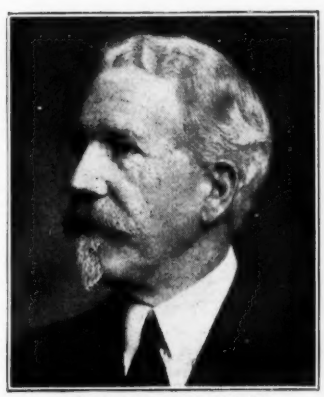
E. H. HOOKER
President
Hooker Electro Chemical Company
New York, N. Y.

L. W. GLASER
Specialty Sales Manager
Littleford Bros.
Cincinnati, Ohio



FREDERICK P. BOWDEN
President
Lord & Burnham Co.
Irvington, N. Y.

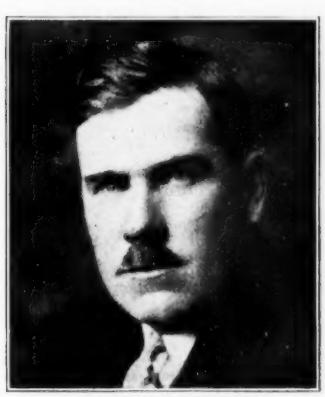
WALTER KELSEY
Lord & Burnham Company
Graybar Building
New York, N. Y.



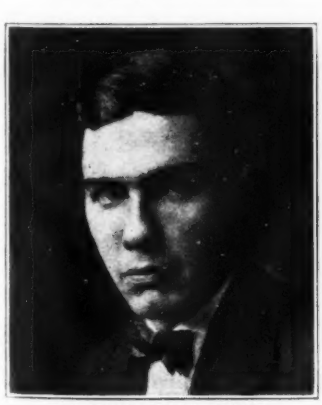
JAMES H. CALDWELL
Chairman of Directors
The Ludlow Valve Mfg. Co.
Troy, N. Y.

WILLIAM H. LOLLEY
President
The Ludlow Valve Mfg. Co.
Troy, N. Y.

ROY E. NELSON
Vice-Pres. and Genl. Mgr.
Howard-Cooper Corp.
Portland, Ore.

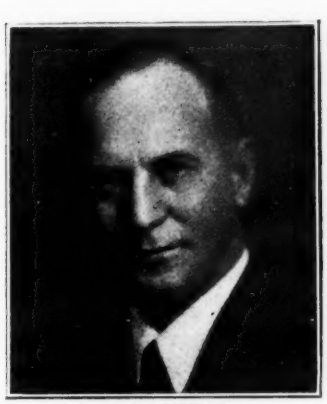


E. J. McCARTHY
McCarthy Well Company
St. Paul, Minn.



J. FRED McCARTHY
McCarthy Well Company
St. Paul, Minn.

W. B. REINICK
McCarthy Well Co.
St. Paul, Minn.



A. M. SHENK
Manager of Sales
McEverlast, Inc.
Los Angeles, Calif.

JOHN W. MABBS
President
Mabbs Hydraulic Packing Co.
Chicago

JOHN A. KIENLE
Vice-President in Charge of Sales
The Mathieson Alkali Works
New York, N. Y.

R. J. QUINN
Asst. Mgr. of Sales
The Mathieson Alkali Works
New York, N. Y.

ELDON S. CLARK
Engineer
Michigan Valve & Fdry. Co.
Detroit, Mich.

C. E. HAGUE
Cleveland District Manager
Mich. Valve & Fdry. Co., Detroit
Dayton-Dowd Co., Quincy, Ill.

F. R. SCHOEN
President
Pacific Hoist & Derrick Co.
Seattle, Wash.

WILLIAM E. CLOW
President
James B. Clow & Sons
Chicago

W. E. CLOW, Jr.
Vice-President
James B. Clow & Sons
Chicago

KENT S. CLOW
Vice-President
James B. Clow & Sons
Chicago

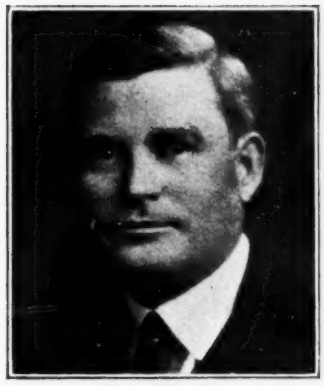
WALTER J. O'DAY
Manager, Chicago
Cast Iron Pipe & Fdry. Dept.
James B. Clow & Sons

FRANK J. EGAN
Asst. Manager, Chicago
Cast Iron Pipe & Fdry. Dept.
James B. Clow & Sons

JOHN McPARTLAND
Special Rep. Cast Iron Pipe &
Fdry. Dept.
James B. Clow & Sons

PAUL A. IVY
Vice-President
National Cast Iron Pipe Co.
Birmingham, Ala.

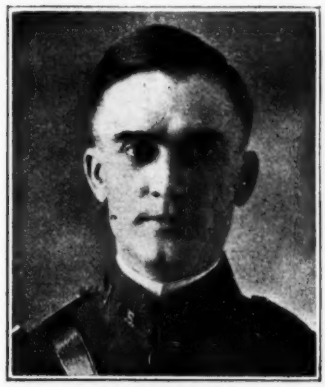
E. E. LINTHICUM
President
National Cast Iron Pipe Co.
Birmingham, Ala.



JOS. W. IVY
Manager Kansas City Office
National Cast Iron Pipe Co.
Kansas City, Mo.

M. T. BRAMMAN
Manager Houston Office
National Cast Iron Pipe Co.
Houston, Texas

RALPH R. SILVER
Advertising Counselor
National Cast Iron Pipe Co.
Birmingham, Ala.



W. G. BLACK
Asst. Mgr. Kansas City Office
National Cast Iron Pipe Co.
Kansas City, Mo.

A. M. AVERY
Manager Dallas Office
National Cast Iron Pipe Co.
Dallas, Texas

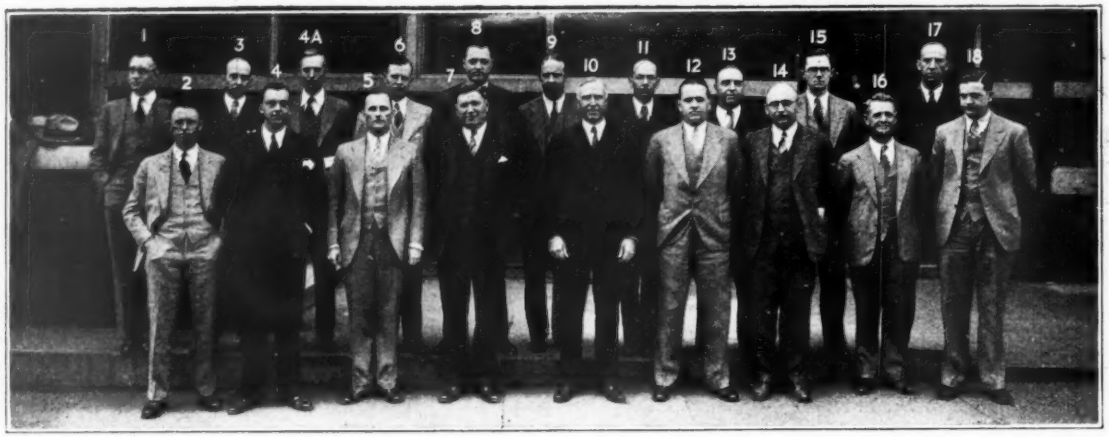
O. A. NELSON
Manager New York Office
National Cast Iron Pipe Co.
New York, N. Y.

W. H. DAY
Vice-Pres. and Genl. Mgr.
Pomona Pump Company
Pomona, Calif.

R. T. MITCHELL
Vice-President
Joseph G. Pollard Co., Inc.
Brooklyn, N. Y.

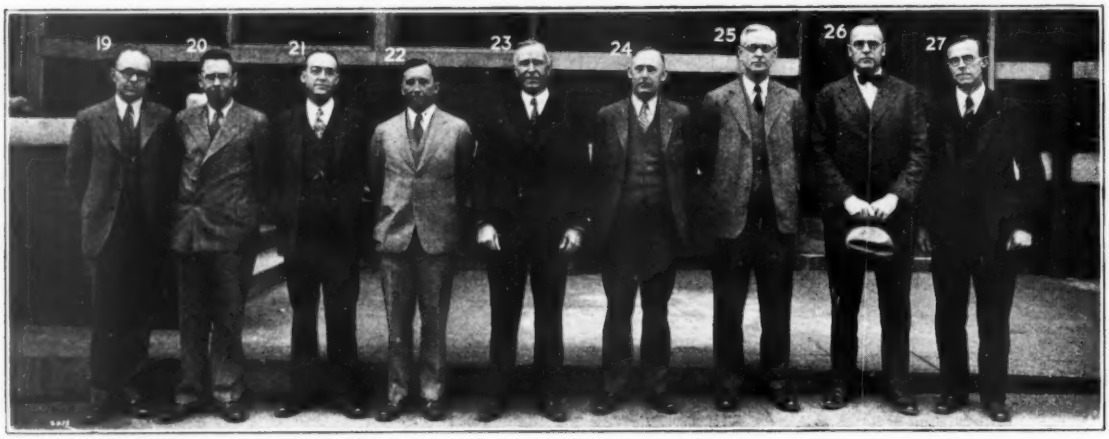
A. R. PANNELL
President
A. R. Pannell Machinery Co.
Oklahoma City, Okla.

JAMES E. WALSH
Owner and Genl. Mgr.
Power Plant Supply Co.
Detroit, Mich.



McWANE CAST IRON PIPE CO. PERSONNEL

1. Arthur K. Akers, Advertising Counsel; 2. J. M. Faunce, Sales Repr.: Birmingham; 3. W. P. Cox, General Sales Manager; 4, Wesley Westmoreland, Jr., Southwestern Sales Manager, Dallas; 4A. P. M. Lovell, Auditor; 5. B. F. Crabbe, Publicity Dept.; 6. A. T. McWane, Treasurer; 7. J. D. Semple, Vice-Pres. and General Manager; 8. P. W. Allen, Eastern Sales Manager, New York; 9. M. M. Grant, Jr., Southern Sales Manager, Birmingham; 10. J. R. McWane, President; 11. W. Lee Roueche, Works Manager, Birmingham; 12. C. H. Allen, Mgr., Kansas City; 13. Shirley W. Harris, Manager Chicago Office; 14. A. W. Claussen, Asst. to Works Manager; 15. S. C. Orr, Sales Representative, Chicago; 16. George Williamson, Research Engineer; 17. William McWane, Asst. to President



PACIFIC STATES CAST IRON PIPE CO. PERSONNEL

19. Dana Kepner, Manager Denver Office; 20, Clyde A. Simpson, Sales Repr., Salt Lake City; 21. Walter Adams, Sales Promotion, Provo, Utah; 22. Geo. E. Sibbett, Gen. Mgr., Provo Plants; 23, J. R. McWane, President; 24. J. L. Hill, Sales Manager; 25, Robert Disher, Manager Portland Office; 26. V. H. Doyle, Manager San Francisco Office; 27. H. M. Dudley, Mgr., Lost Angeles Office.

"A CHEERFUL LITTLE EARFUL"
Manistee Iron Works Band
Manistee, Mich.

H. M. HOWARD
District Manager
Pittsburgh-Des Moines Steel Co.
Atlanta, Ga.

MAXWELL WHITACRE
Manager Chicago Office
Pittsburgh-Des Moines Steel Co.
Chicago

H. W. FORD
District Manager
Pittsburgh-Des Moines Steel Co.
New York, N. Y.

J. E. O'LEARY
Genl. Sales Manager
Pittsburgh-Des Moines Steel Co.
Pittsburgh, Pa.

H. D. FOWLER
District Manager
Pittsburgh-Des Moines Steel Co.
Seattle, Wash.

O. D. DeHART
District Manager
Pittsburgh-Des Moines Steel Co.
Dallas, Texas

E. W. THOMAS, Jr.
Chicago Dist. Sales Representative
Reading Iron Company
Reading, Pa.

H. F. MATTERN
Genl. Sales Mgr., New York
Reading Iron Company
Reading, Pa.

H. S. CARLAND
New York Dist. Sales Rep.
Reading Iron Company
Reading, Pa.

KENT POPE
President
The Pope Equipment Company
Cleveland, Ohio

P. B. ANDREWS
Revere Copper & Brass, Inc.
Rome Division
Rome, N. Y.

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Smith-Booth-Usher Company
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The E. I. Van Doren Companies
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Newark, N. J.

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Harrison, N. J.

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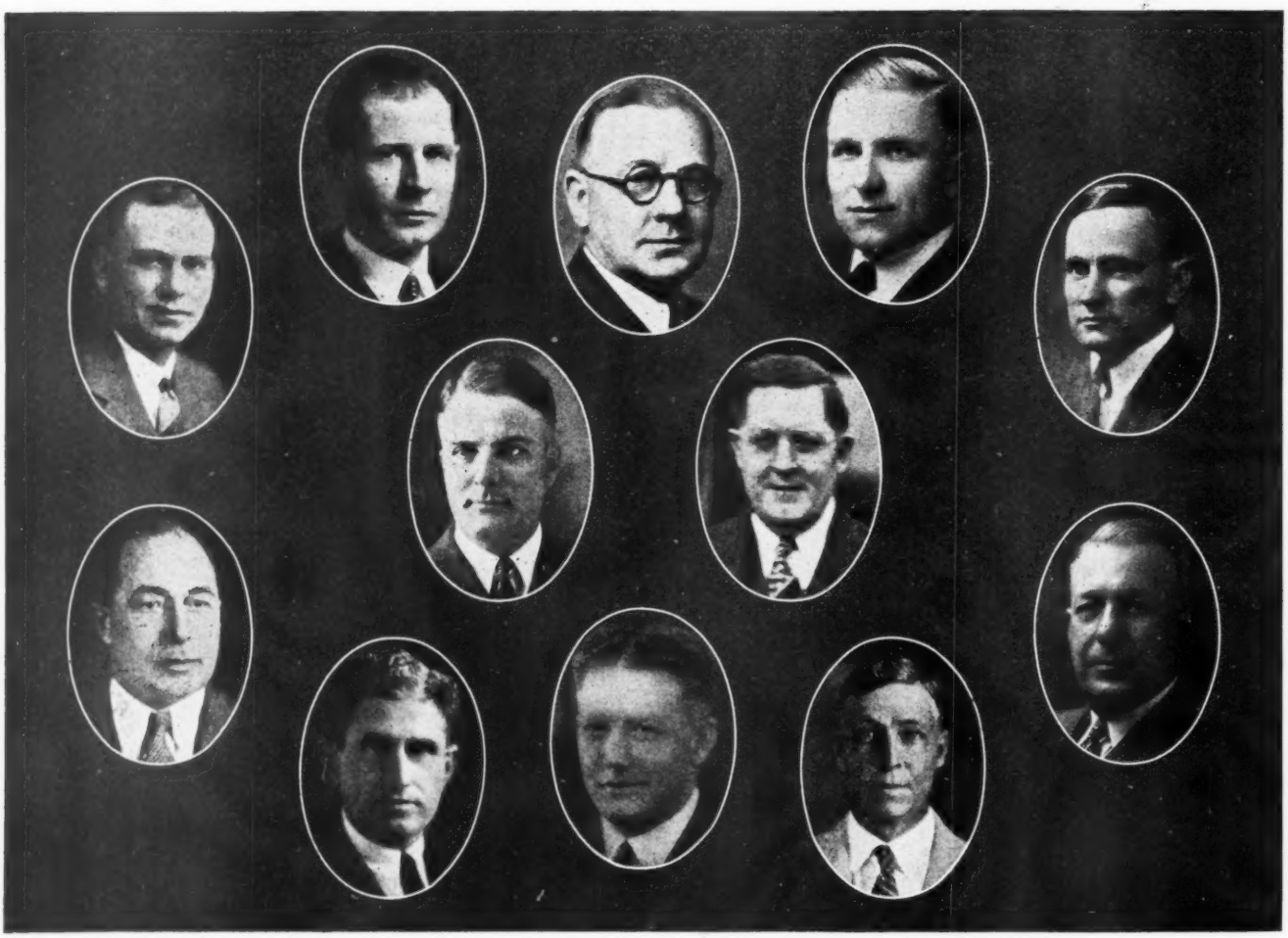

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